Governing circulation, disruption, and emergency on the London Underground: a theory of logistical power

Governing Circulation, Disruption, and Emergency on the London Underground:

A Theory of Logistical Power

A Dissertation Submitted to the Department of Politics and Graduate Research School of Birkbeck College, University of London, in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Abstract

The following thesis argues for and – using the case study of the London Underground – elaborates upon the idea of logistical power as a framework for understanding contemporary forms of urban governance (in particular in the post-industrial cities of the 'global North'). This is a framework evolved from attention to the dual heritage of logistics: its military origins on the one hand, wherein it was key to the management and minimisation of the frictions of circulatory systems, and its work in the corporate sphere, on the other, through which it became practiced in discovering and extracting novel forms of value from circulation. Today, this set of ideas, calculations, spatial, sensory and affective mechanisms is increasingly applied, I will argue, to urban infrastructures in the context of a claimed unprecedented level of uncertainty and risk, together with intense financial pressures. Theoretically, the thesis will claim that the prominence of logistics in the governance of circulation forces us to reconsider the binary of the tactical and the strategic; of systems and their disruption, upon which the political stakes of urban infrastructure have been wagered.

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Acronyms & Abbreviations

API:	Application Programme Interface
BCM:	Business Continuity Management
BSI:	British Standards Institute
BTP:	British Transport Police
CBRN:	Chemical, Biological, Radiological or Nuclear
CBTC:	Communications-Based Train Control
CCA:	Civil Contingencies Act 2004
CCS:	Civil Contingencies Secretariat
CDA:	Critical Discourse Analysis
C(N)I:	Critical (National) Infrastructure
CIP:	Critical Infrastructure Protection
COR:	Centro de Operações Rio
CRIP:	Common Recognised Information Picture
CT:	Counter-Terrorism
DfT:	Department for Transport
DHS:	(US) Department for Homeland Security
ESN:	Emergency Services Network
ERU:	Emergency Response Unity
FDNY:	Fire Department of New York
FEMA:	Federal Emergency Management Agency
GLA:	Greater London Authority
ICTs:	Internet and Communications Technologies
IEM:	Integrated Emergency Management
IoT:	Internet of Things
LAS:	London Ambulance Service
LBS:	Location-Based Services
LCH:	Lost Customer Hours
LFB:	London Fire Brigade

LU:	London Underground
LUCC:	London Underground Control Centre
MaaS:	Mobility as a Service
MTFA:	Marauding Terrorist Firearms Attack
NaCTSO:	National Counter-Terrorism and Security Office
NIRMs:	Network Incident Response Members
NPIA:	National Policing Improvement Agency
NPM:	New Public Management
NRA:	National Risk Assessment
NRR:	National Risk Register
NSS:	National Security Strategy
OIE:	Organization International des Épizooties
OOH Advertising:	Out Of Home Advertising
OPP:	Obligatory Passage Point
POL Warfare:	Petrol, Oil, Lubricant Warfare
PPP:	Public-Private Partnership
RAND Corp:	Research ANd Development Corporation
RFID:	Radio Frequency ID
SIDOS:	Security In Design Of Stations
SRU:	Specialist Response Unit [see ERU]
TETRA:	Terrestrial Trunked Radio
TfL:	Transport for London
TOC:	Train Operating Company
UPS:	United Parcel Service
Urban OS:	Urban Operating System
VSS:	Vital Systems Security
XR:	Extinction Rebellion

Introduction – Keeping London Moving

'Keeping London Moving', for those not familiar, is the motto of Transport for London (TfL), the subsidiary organisation of the Greater London Authority (GLA) responsible for coordinating the city's multiple transport modes – including the central case of the current project, the London Underground (from hereon in 'LU', 'Underground', or 'Tube'). In some sense, everything that this thesis contains can be extrapolated by addressing the questions 'what', 'why', and 'how' to this motto.

What is this 'London' that is being kept moving? What is it made up of? Cities are citizens, of course, and cities are the built environment; they're *structure*. But since it moves, London is not a static ontology; it is a being that circulates. The city moving is the city as *infra*-structure, both materially and socially.

Why does the city move? Why is it bad if it doesn't? The city must move in order to reproduce itself. Its functions are not contained in one place or another; rather they consist of dispersed elements which must meet or connect (often on a daily basis) to create *value*. People do not just 'do' work, they must first 'go to' it. *Disruption* to such processes means decay, but also, potentially, dangers or *risks* of various kinds. People are left without goods and services which fail to arrive, or, alternatively, people themselves become stranded, trapped, or exposed.

Most importantly, *how* is this movement achieved? Or, rather, how is 'keeping…moving' achieved? Though it brings a certain symmetry and rhythm to the phrase, it is doubtless a clumsy combination of words. It is notable because it indicates that the city does not *only* move; it must *keep* or *be kept* mov*ing*. 'Keeping…moving' is an act of maintenance at the same time as it is an act of dynamism. Things must move in order to remain; that is, to remain in a *state of circulation*.

One potential answer to this 'how' would be a matter of making or enforcing; of sanctioning certain times and spaces for stasis and movement. For some, in particular those that are homeless or 'undesirable', remaining in one place becomes 'loitering' or 'vagrancy', acts subject to security and surveillance. In addition, there is undoubtedly the role of subjectivity. A city that moves, that values movement and seeks to keep moving, constitutes urban subjects according to this image; according to *ideals* and *desires* of mobility. Those that move (through choice and often for an economically productive purpose; for work or consumption) hold themselves to be more 'modern' and more 'free', and disruption appears to them as a threat, a source of insecurity.

Yet, in addition to these quite grand concepts, there are also more material, sensory, performative, and iterative ways of encouraging and communicating circulation. It was a moment of coincidence towards the end of the second year of this project which made me realise the significance of such technics. By this point, I'd settled on writing the thesis in a given font – the font you, the reader, see in front of you now: Gill Sans MT. I had decided on this font, from a dropdown list of 422 others, because, as far as I can remember, it seemed to convey a certain sense of authority without seeming dull or dated. It had professionalism, seriousness, gravitas, but also a sense of contemporaneity, a slickness. Some time later, I was reading David Long's study of LU architecture for what would become the sixth chapter of this manuscript, and came across a section on the history of the Underground's patented font, Johnston Sans. As will be discussed later, the font's creator, the influential British calligrapher Edward Johnston, was commissioned by London Transport to create a typeface that would project a sense of coherence and trustworthiness onto the organisation's brand, but in the way it is now deployed it also serves, affectively and aesthetically, to maintain calm, assured, and timely circulation through the network. This was something I found interesting in itself, that is, *as an idea*, a concept, but what really

solidified my attention was the discovery that Johnston's apprentice was Eric Gill, that is, the creator of Gill Sans. Beyond the idea of something like font as a potentially influential factor in how the Underground communicated itself therefore, it turned out that I was already practicing this minutiae of communication myself. Unbeknownst to me (at least on a conscious level), I had been writing not only *about* the Underground but *in and through its form*.

The vignettes below begin, by way of concrete examples and experiences, to open up the problematics posed by the 'what', 'why', and especially the 'how' introduced above, leading us into the literature review with an impression of the need to account theoretically for the diversity of circulatory governance. These vignettes additionally help to introduce an initial, broad research question, which may be stated as follows:

- How is the London Underground, as a specifically urban space of circulation and disruption, governed, and how do the knowledges and practices deployed here compare to those deployed in the governance of other urban spaces and systems?

Feeding into this primary question are a set of secondary queries addressed to the London Underground specifically:

- How is risk conceptualised?
- What spatial techniques are deployed to manage circulation and disruption?
- How are passengers enrolled in the task of governance?
- What are the role(s) and effects of uses of technology in governing circulation and disruption?

The emphasis of the following is thus on the particularities of the London Underground, but always with consideration of what the knowledges and practices deployed in relation to that space can tell us about circulatory urban governance more broadly.

Shakespeare and Spinach: Three Vignettes of Underground Governance

> "It was Stendahl who told me a wonderful story. From the age of thirteen to the age of fifty-three, without the slightest variation, with the greatest faithfulness, he had two passions. A passion for Shakespeare and a passion for spinach…It seemed to me to be a marvellous definition of writing…that the great is small, depending on your point of view…It's a transmutation of values, in true life and concretely. And provided that the great and small blend together, as in Shakespeare, everything ordinary is endowed with a supernatural quality"
>
> (Cixous, 1998: 40)

The following introductory section is arranged around three separate vignettes taken from a research diary of observations and ideas kept throughout the project. Each invites us to consider a selection of concepts, spaces, contexts, and actors prescient to the subsequent thesis; all its moving parts. It is part of the intrigue of these vignettes that their settings range from what are traditionally considered positions of oversight; command and control, to the most mundane of interactions at, or rather below, street level. Indeed, what I feel is at stake is the oscillation between these two scales; the holding together and transmutation, as Hélène Cixous puts it, of 'Shakespeare and spinach', of grand strategies and minute, seemingly insignificant and momentary performances.

In addition, the vignettes indicate a variety of diverse themes; a combination of circulation, logistics, risk, temporality, spatiality, materiality, aesthetics, discourse, affect, code, communication, navigation, surveillance, and value. Whilst the subsequent literature review will aim to couch these terms in relation to relevant theoretical work and historical context,

the objective here is simply to begin unpacking their meaning, and the ways in which their various deployments in the specific context of the London Underground begin to pose a set of wider problems and questions worthy of exploration.

23rd January, 2019, London Underground Control Centre (LUCC), Palestra House, Southwark

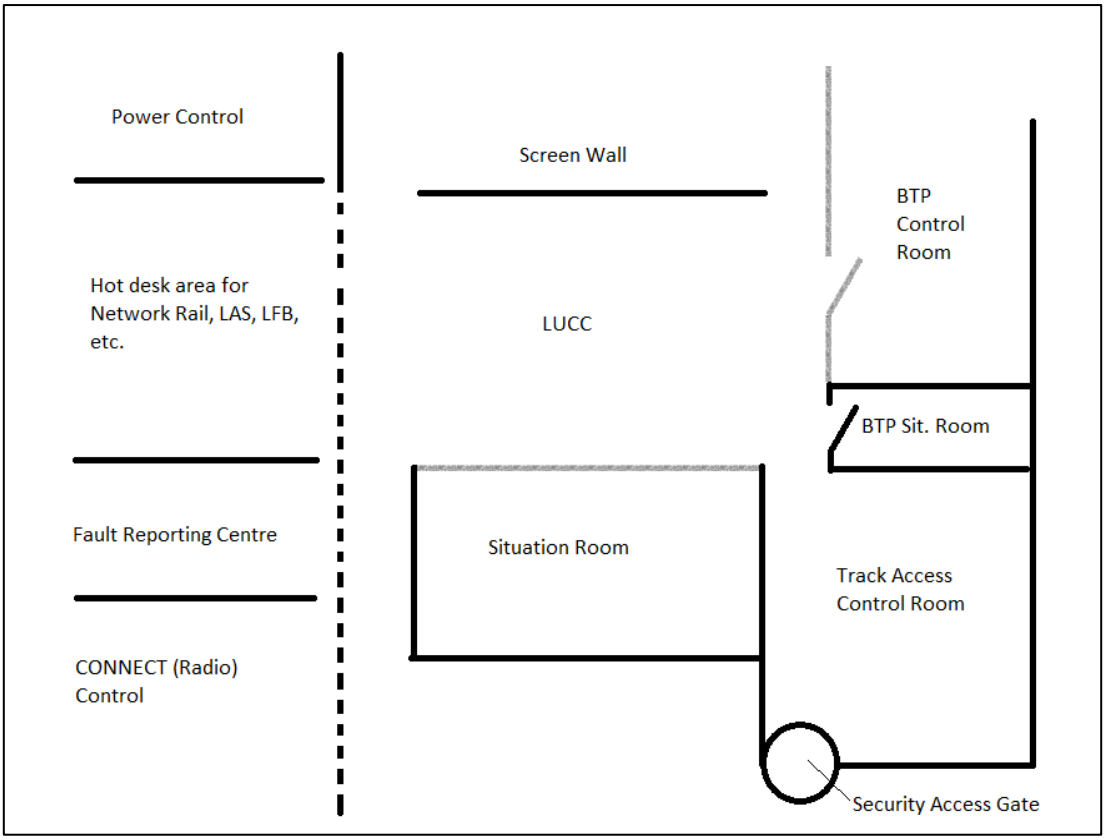


Figure 1: Sketch showing the layout of facilities surrounding the LUCC (source: Author)

What is immediately apparent to me as I am led into the control room is a surprising tranquillity. The atmosphere of the space is airy, quiet, and light-hearted, where perhaps I expected something bustling, chaotic even, and deadly serious. I am introduced to the shift commander for that morning, and then me and my guide stand at the back of the room and gaze towards its most prominent feature, the large screen wall that sits front and centre, visible from every one of several individual workstations. The wall is made up of a multitude of monitors. Their displays include a bespoke selection of CCTV feeds of platforms, a live map of London showing ongoing incidents (both transport and non-transport based), a 24-hour news channel and, stretching across the whole width of the bottom level, a line diagram indicating the positions of vehicles across the network. Finally,

on the far right of the wall is an oversized Twitter feed, displaying both TfL's own activity and all notable incoming tweets relevant to their work.

The incident when it arises is not announced as such. Rather it comes into being in the control room via a number of brief, subtle actions and exchanges between its members and its technological components. Suddenly, bodies and eyes swivel to focus on the screen wall as the camera streams switch to the image of a train stationary on the Northern Line platform of Warren Street station. The shift commander picks up a radio from his desk and immediately begins speaking to London Underground staff on the platform. Meanwhile, a group of what the Control Centre refer to as 'NIRMs' (Network Incident Response Members), a combined team of paramedics, engineers, counter-terror, and CBRN specialists from the Underground's Emergency Response Unit (ERU), are immediately called towards the site of the incident. The train is being held because a woman on board is having a seizure. Usually, I am told, a passenger who has fallen ill would be removed from the train within a few minutes. However, in this case a neck or spinal injury is suspected, and as such the patient cannot be moved without being professionally assessed. We watch as, within a matter of minutes, paramedics from the ERU arrive and board the train. At this point, the incident is upgraded to a Category 2, and then, almost immediately, to a Category 1 level of severity, and the Control Centre operators make the decision to suspend the Northern Line service. We look on as the train is evacuated, passengers streaming onto the platform and for the most part moving off it to continue their journey via an alternative route. From another corner of the room, the network information board is updated, communicating the suspension of the branch to passengers and anyone accessing TfL's website. A number of minutes later the passenger emerges from the carriage on a stretcher, and disappears off the edge of the monitor. With this vanishing act, the room quickly turns to reinstating the service and broadcasting this return to normal functioning.

> *Just as rapidly as the situation had (been) escalated, it de-escalates, and, eventually, as the previously stricken train slinks off into the tunnel, the atmosphere of urgency seems to dissipate. An elderly man who had been unsure whether to board is left on the platform as the doors close, prompting someone to point at the monitor and remark: "this poor fella's missed it look". A sympathetic chuckle breaks out around the room, before the control centre returns to its prior state of relative peace.*

What is most evident in this observational account of the everyday functioning of the Underground's control centre is the proficiency and speed of relay and (de-)escalation. As we are informed after the incident, the rapidity of the event's resolution is central to the purpose of the LUCC. With one train's delay due to one passenger's illness, the entire branch is suspended and the system as a whole will feel the effects. The time taken between the initial stoppage of the train and its return to service will be recorded and fed into statistics and (weekly, monthly, and annual) targets according to the measure of 'Lost Customer Hours' (LCH) – thus also influencing the distribution of resources and future policies. Indeed, when space allows, one of the displays on the aforementioned screen wall is used as a stopwatch, ensuring that all involved are aware of the importance of each second that ticks by.

There is a distinct rhythm to the LUCC then, which perhaps we could call a rhythm of events; not a linear temporality but something that seems wholly centred around the rise and fall of singular periods of action. Nor though is this rhythm just cyclical, in that it is not the same event on repeat. Each situation is to some extent unique, and requires a tailored response. The rhythm is temporal, but also spatial, material, aesthetic and affective. Spatially and materially, it is a process of reaching out; an extension of temporary linkages between human and non-human components within and outside the room. The outset of the

incident, for example, is marked by people looking up from their individual workstations to communicate with one-another via the mediator of the screen wall or the radio. Relays are made and forces are put on the move; positions are established and updated; capabilities are matched to the situation as its elements are unveiled. Aesthetically and affectively, it is a process of building sensory alertness and urgency; a tensing or straining of vision and hearing, a wielding or gripping of instruments, a straightening of spines. And, at the disappearance of the train into the tunnel, a subtle release: humour, chatter, and a return to relative calm (see Anderson & Adey, 2011).

Given the centrality of the screen wall, the temptation is to see the LUCC as a digitised panopticon, an all-seeing eye. However, the second important point observable from the account above is that information flows in both directions. The control centre depends upon its eyes on the ground (station staff, the 'NIRMs', and members of the Twitter public) in order both to identify the incident in the first place, and then to constantly tweak its response as the situation develops. Such an observation reminds us to pay attention to everyday interactions outside the control room, of which the following vignette provides an example.

4th September, 2018, 13:46 – Baker Street, Bakerloo Line Northbound Platform

I feel a tap on my shoulder. I turn to find a woman, with a man and two children behind her. All of them have suitcases. The woman doesn't speak much English. She gestures urgently to the map on the wall, pointing at Uxbridge. I reply "ah okay". I trace back from her finger to Baker Street, and then back along the Metropolitan. I tell her, "you have to take the Metropolitan. This one. All the way". She hesitates. I say, "so not this platform, this is the Bakerloo". She looks at the area of the Baker Street interchange on the map, trying to make out how to get to the Metropolitan Line by studying the thick white interchange line from the brown to the purple. The white line heads diagonally up and right. "Upstairs?", she asks. I realise I don't know how to reply to that. Instead I step back from the map, pointing

> *at the sign above our heads. "Follow the sign to the Metropolitan, the purple". The woman nods immediately, gestures frantically to her family, and sets off down the platform.*

In this roughly 20 second encounter with a tourist on a Bakerloo line platform, we are dealing not with the relatively top-down, centralised idea of the control centre which oversees the network from outside it; which reaches into it only on occasion. Rather, this is an example of an attempt – one of countless similar episodes each day – to negotiate the space from within via its representations.

We could initially make the common observation that, in transport hubs, and especially urban metro stations, the map plays the role not of mere representation, but rather of a tool mediating action, interaction, and movement. Before any journey within the city, the majority of Londoners will access some kind of schedule, whether a list of departure times, or a personal route calculated via digital means on a mapping application or TfL's 'Journey Planner'. Yet this should be distinguished from the episode above, which involves interaction with such tools within the network itself. This is a bodily as well as visual process, as exemplified by the act of 'tracing' along the lines with one's finger. And there is an urgency to it, a feeling that my ability to communicate this information quickly and accurately may have significant consequences for this family. The suitcases suggest to me that they may have another connection to make. It is an urgency which expresses a need to get *from A to B*.

Moreover, there is a distinction to be made between this usage of the map on the wall as a tool of impromptu planning, and the perhaps even more mundane, immediate procedure of navigation. There is a break in the example above where my interaction with the woman through the map (tracing, planning) is – as a result of its failure to convey the interchange – substituted for the 'point' and 'follow' of the sign above our heads. There are strange things tangled up in this all-too-simple act. For one thing, we 'point' to a 'point' (that is, a static

point) that 'points' beyond itself. We point to an arrow, and in doing so we also become an arrow; we lean or extend ourselves into that other space on behalf of those we are trying to direct. But all we do is point to the next sign (and all that sign does is point to the next, and so on).

This account, in sum, constitutes a warning that, whilst we must pay attention to the role of representations, we should also be aware that there is more to circulation than the network as a symbolic, abstract entity.

4th October, 2017, Northern Line, between Euston and Warren Street

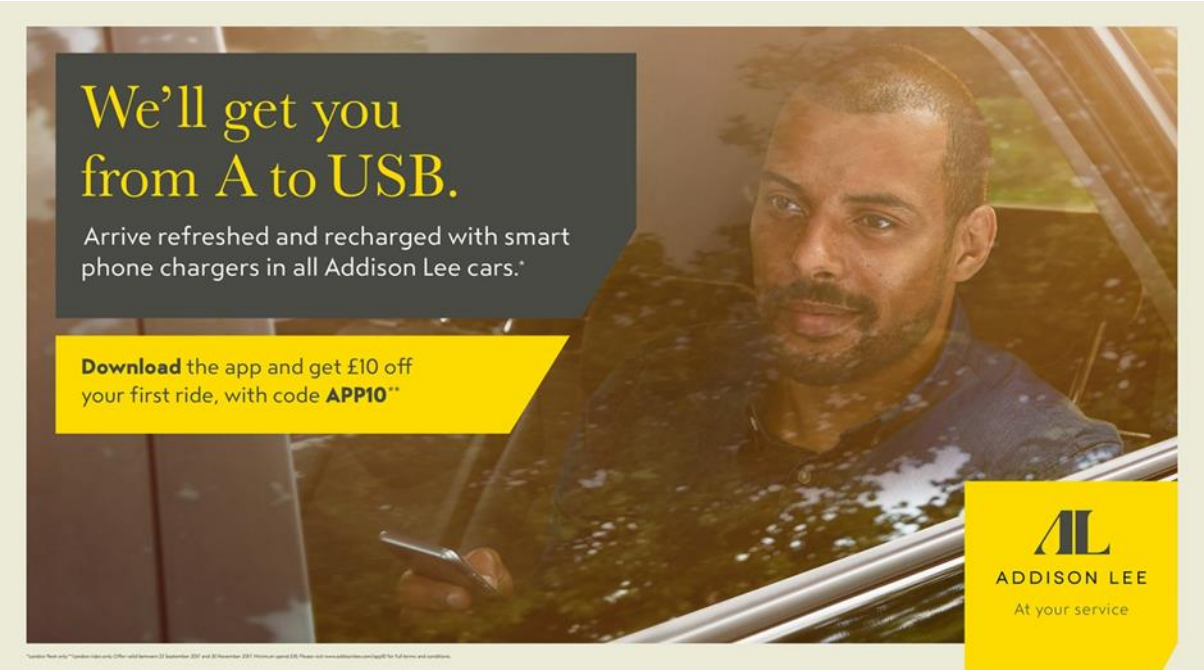


Figure 2: 'We'll get you from A to USB'

Squeezed into the corner of the carriage, I gaze aimlessly towards the band of advertising on the curved surface of the roof's interior. A specific poster catches my eye. It is an advert for the luxury taxi service Addison Lee. The tagline – "We'll get you from A to USB" – is the first thing to draw me in. It refers, as the sub-text explains, to the fact that Addison Lee cars contain smartphone chargers. However, it strikes me that the very reason for my engagement with the poster is my current suspension between A and B. The message together with the position of the advert seem in this way to parody or even mock the position in which all of us in this carriage are held – 'wouldn't you rather be here?', it asks.

> *The advert's actor, a smartly dressed man, stares from the car window, a look of serenity on his face. We might initially think that the source of the serenity is the view of nature alluded to by the trees reflected in the glass; until, that is, we spot the phone resting in his palm. The comfort and calm arises, we realise, not only from the smoothness of the journey, nor the leather-cushioned seats, but out of freedom from the anxiety of disconnection.*

Whereas the second vignette highlighted the urgency of A to B, this excerpt emphasises this desire whilst also revealing its inadequacy – the fact that something exists between the letters. In the case above, this 'something' is twofold. Firstly, it is the advertisement; the material and discursive 'thing' of the advertising poster. Secondly, it is the digital and commercial exchange invoked by the word 'USB'; the invitation to make the best of the suspension between A and B by downloading the app and making a purchase. Though it seems to parody the Underground's lack of digital connectivity therefore, it also depends upon it, the commercial invitation sent out in the knowledge that free WiFi is increasingly common on the network. The advert depends, then, on *a synchronicity between connectivity, mobility, and the extraction of commercial value*.

From the above accounts, it is hoped that we can get an initial understanding of the intersection of ideas that will come to animate this thesis and its theoretical contribution. Fundamentally, this is the intersection of two objectives: one, that of making circulation – that is, the urgency of the A to B – more resilient by enabling rapid, flexible, and coordinated responses to disruption; and two, that of extracting added value from the interstices of that circulation. I will argue that, while the frameworks most commonly deployed to comprehend the governance of urban infrastructure and circulation, such as resilience-thinking and smart urbanism are useful points of reference, the duality of this aim can be captured more effectively through the concept of logistical power. Logistical power is indebted to Collier and Lakoff's (2008; 2015) Foucauldian interpretation of contemporary liberal governance as 'Vital Systems Security' (VSS). However, in view of efforts to render

circulations on the London Underground not only more resilient to dynamic forms of risk, but also more valuable, and the expertise of logistics and advertising firms in doing so, logistical power marks a significant departure from VSS as a form of 'collective security'. Moreover, logistical power includes but also expands beyond considerations of subjectivity, (self-)conduct, responsibility and (strategic) representation to examine the material, spatial, mobile, aesthetic and affective means by which frictions are managed.

In short, logistical power is Shakespeare and spinach, an oscillatory form of power which transmutates the long-held binaries of risk and value, strategy and tactics, circulation and disruption.

The chapter outline below will now set out the order of my argument more clearly.

Chapter Outline

Beginning with the oft-cited idea that urban governance in the post-industrial 'Global North' has turned to a 'resilience' approach in attempting to deal with an unprecedented degree of technical complexity and unpredictability, *chapter one* builds upon the claim that, rather than representing an abandonment of governance to contingency, this framing of the world has in fact given rise to novel forms of knowledge and practice intended specifically to enable action despite radical uncertainty. It should be noted that, rather than a traditional literature review, this chapter represents an attempt to identify and critique a number of key strands of thought – how they have developed both historically and conceptually – as well as to explain the ways in which these concepts as I see them interact, overlap, but ultimately leave a space that is under-theorised.

The chapter takes as a central concept Collier and Lakoff's (2008; 2015) Foucauldian notion of 'Vital Systems Security' (VSS) – the idea that contemporary liberal governance holds, as a

key responsibility, the protection of those infrastructures crucial to sustaining modern life, but susceptible to potentially catastrophic failures as a result of their complexity and interdependence. In particular, VSS enables us to assert that, rather than a specific capacity which becomes necessary in light of novel, uniquely unpredictable kinds of threat associated with terrorism or 'late-modern' technologies, the current 'resilience turn' is embedded in broader forms of governmentality. The chapter argues therefore that the need to manage radical uncertainty has always been a prime concern for liberal rule, especially in an urban context. Although it is now manifest in attempts to govern the techn(olog)ical complexity of systems, it has its precursors in attempts to govern the socio-political and spatial complexity of urban populations, and the ever-present possibility of unrest and sedition inherent to them.

VSS is based upon a particular form of knowledge, 'system-vulnerability thinking', which attempts to model or enact the effects of potential emergencies. In this sense it corresponds to an 'all-hazards' approach, wherein resilience is achieved by building generalised preparedness for responding to and recovering from any conceivable event. As others have noted however, the recent work of emergency bodies such as the UK Civil Contingencies Secretariat is based upon the need to act upon the 'within' of the event, intervening in its evolution and curtailing or diverting its spread. Consequently, the chapter shifts attention towards the specific capability of 'rapid response', which puts an emphasis on speed, going out to meet the event in its emergence.

Given the importance of anticipatory and real-time forms of monitoring to rapid response approaches, the growing prominence of such techniques has been linked to the use of ICTs and 'smart' technologies in the management of urban flows, a set of developments criticised by certain observers as driving the 'corporatisation of city governance'. Whilst I argue that

these important patterns must be taken into account, there is also recognition here of the need to avoid reducing circulatory governance to neoliberalism. As such, the chapter concludes by asking whether we might need to diversify our theorisations of governance in liberal urbanities to account both for the idea of securing circulations against potentially catastrophic risk-events, and for the influence of a corporate rationale functioning according to principles of cost-minimisation and profit-maximisation.

As a way of conceptualising the tense coexistence of the resilient and the smart, risk and value, I turn in chapter two to a third literature, that of logistics. Logistics, I argue, has the potential to help us encapsulate the duality of aim involved in circulatory governance, but only if we take into account both its military origins, and the ways in which, over the course of the late 20th century, it has shaped, and been shaped by, its work in the corporate sphere. Within this sphere the so called 'logistics revolution' involved both the idea of resilience to frictions and disruptions which might threaten the smooth flow of capital, and the more positive notion that circulatory vectors represent previously unexploited frontiers for the extraction of value. In addition, I draw attention to recent writing on logistics that emphasises the material, aesthetic and affective properties of circulations and the roles they play in both attempts to maintain the order of circulation, and attempts to disrupt this order as a means to amplifying political claims. I conclude the chapter therefore by tentatively posing an augmentation to Collier and Lakoff's framework based around a logistical form of power that is more multi-faceted and potentially more wide-ranging than VSS.[1]

[1] Although this augmentation to some extent abstracts the historical specificity of VSS, it is not intended as an ahistorical or universalising claim. Rather, what I call logistical power should be understood as the product of a milieu of historically and geographically specific trends. Whilst in the current project I did not have adequate time to examine the scope of this form of power, it is inevitable that it has its limits, both spatially and temporally. It is likely, for example, that logistical power could not be addressed in the same way to the governance of infrastructures in the Global South. Nonetheless, as I will mention later, there are certain trends which are currently exporting the knowledges and practices explored here, putting them to work in very different contexts. Whether or not 'logistical power' can still be used to describe this work is a question for future projects.

In order to explore these theoretical issues, I carry out an in-depth case study of the London Underground metropolitan railway system. This case was chosen for a number of reasons which are discussed in detail in *chapter three*, but a key part of the rationale was that the Underground was in many ways *the* first network of its kind in the world, and that in part because of this longevity it is a space which has developed a deep-seated cultural and symbolic (as well as economic and political) significance to London, and a complex relationship with ideas of circulation and risk. In my opinion, there are few better examples of an everyday, circulatory urban space that is considered simultaneously so vital and so vulnerable.

In *chapter four*, I outline my methodology and method. I argue in particular that the theoretical framework of logistics – as a form of power that oscillates between strategy and tactics – necessitates an approach that studies neither only discursive regimes and ideological complexes, nor only small-scale interactions, but rather focuses on the interactivity between these two levels of analysis.

In the first empirical chapter (*chapter five*) the LU is positioned within broader conceptions of urban risk. Here it is argued that the Underground, due to the *social and spatial complexity* of its environment – characterised by density and enclosure, but also openness and a transitory populace – poses special difficulties for governance. Risk, in the Underground, is not only potentially catastrophic but also *dynamic*: mundane, regularly occurring events can, quickly and with little warning, transform into far more serious incidents if not monitored and intervened in with adequate speed. At the same time, the Underground is operated by a public organisation which, like many others, is currently under intense financial pressures. In this context, the previous prominence of multi-agency exercising and enactment as an approach to uncertainty appears to be receding in favour of an approach that attempts to

integrate the potential emergency into everyday operations via the principle of 'scalable' response. This is enabled, I argue, by the growing influence of logistical technologies and expertise which promise both to enhance the resilience of the system, and, at the same time, to contribute to operational efficiencies and generate additional revenue.

Evident here is a form of governance that functions through operations of feedback between the strategic and tactical levels, tending to enrol not only frontline staff but also passengers and their immediate environment. In the second empirical chapter (*chapter six*) therefore, greater emphasis is placed upon how the circulations of passengers around the network are managed more immediately. It becomes clear that logistical power is by no means exclusively digital, nor is it smooth or seamless. Rather, its unique character is expressed precisely in how it seeks – through the meticulous arrangement of material elements and sensory cues – to manage forms of friction, whether physical obstacles or affective hesitations. Moreover, it is claimed here that, in response to the aforementioned financial pressures, governance of the Underground environment increasingly involves balancing the imperative of onward movement with the need to boost revenue streams through retail and advertising. In part through the possibilities of 'real-time data', but also through the flexibility of the material environment and its range of aesthetic and affective cues, the potential is suggested for extracting added value from the duration of circulation itself; from within passenger journeys.

In the concluding chapter (*chapter seven*), the arguments of the empirical sections are summarised, and the theory of logistical power is refined. In addition, this chapter examines the wider consequences of logistics for urban governance and, in particular, the socio-political, affective and sensory experience of the urban and its infrastructures. The chapter argues that forms of critical engagement with logistics require greater attention to the

notion of infrastructure as social and sensory space, rather than merely a network of distribution, flow, or connection. Moreover, it proposes that forms of subversion must look not only to counter strategic abstractions with tactical agitations, but rather to work on logistical mechanisms themselves.

1. Literature Review – Calculating Urban Disruption: Resilience, Smart Urbanism, and the Turn Toward Logistics

1.1. Introduction: Resilient? Smart? Both?

> "rather than a liberal understanding of human political collectivities ruling over life, resilience-thinking insists that life has to rule or govern policy-making"
>
> (Chandler, 2014a: 51)
>
> "the ambition at the heart of the smart city is nothing other than control"
>
> (Greenfield, 2017: 48)

Governing urban societies today, particularly the post-industrial cities of the so-called 'Global North', is frequently claimed to be orientated around questions of uncertainty, unintended consequences, side effects, and the potential for catastrophic events. Contemporary forms of emergency governance, in particular, are said to have to cope with unprecedented levels of precariousness associated with the complexity of late-modern, and especially urban, life. Complexity arises from the 'networked' nature of this existence, rooted in the scale and interdependence of urban infrastructures: systems uniquely vulnerable both to intentional threats and accidental failures due to their 'closely-coupled' character, meaning that disruption to one infrastructure 'cascades' across into others in unpredictable fashion. The effects of such virulent processes are widespread, leading commentators to question the relative certainty of modernist, linear perspectives on technological progress, and the mechanism of risk through which it was previously thought

threats could be rationally assessed (according to likelihood and severity), and correspondingly prevented or insured against.

As a response to this claimed vulnerability, many have identified a turn to 'resilience' approaches as a means to think anew about governance, and more specifically to prepare for and recover from the inevitable and unpredictable future event. Moreover, for some, 'resilience-thinking' supplants efforts to know and to secure, surrendering the pretence of purposeful change for modest, small-scale interventions and a focus on learning lessons (Chandler, 2014a; 2014b). On the other hand however, an equally popular notion, that of 'smart urbanism', appears to renew and advance the possibility – whether viewed as promise or spectre – of security, control and prosperity via the use of technological capabilities such as 'big data' analytics, 'real-time' communications, and the Internet of Things (IoT). Again, such technologies often focus on urban infrastructures, with the aim of anticipating or pre-empting a broad range of potential disruptions (Greenfield, 2017: 50).

This brings us to a situation of tension or paradox. In the same moment that governing agencies – not only governments, but also civil servants, business leaders, and so on – seem to be admitting that they are unable to provide security or control, the presence of technologies and facilities promising to do just that (from algorithmic and real-time modelling techniques, to control centres and urban dashboards) become increasingly ubiquitous features of the urban environment (Mattern, 2015).

This chapter is set up in part as a response to the coexistence of resilience-thinking and smart urbanism; rubrics which, whilst having much in common – 'smart' projects are often promoted as making cities or systems more 'resilient' and vice versa – seem to hold markedly different attitudes towards governing: the former a constrained outlook founded upon acceptance and the need for adaptability and continual learning; the latter a

perspective that verges on the utopian in its aspiration to monitor, calculate, and provide solutions to life in its entirety and as it happens. Rather than arguing for the 'reality' or benefits of one of these perspectives over the other, my aim is to understand how they came to coexist and how we might conceptualise this coexistence. I claim that the answers might be found in a third literature: the literature on 'logistics', a set of ideas which has always – since its origins in military theorising of the 18th and 19th centuries – struck a certain balance between control and its impossibility; between (the fantasies of) the frictionless and (the inevitability of) friction; the abstract ideal and the unfolding of the real; planning and opportunism; anxiety and reassurance; humility and ambition.

The central objective of this chapter as such will be to utilise relevant literature to argue that neither resilience-thinking nor smart urbanism, whilst both undeniably providing important frameworks for understanding, quite get to the heart of what is involved in governing urban infrastructure. While the concept of resilience – coming from a security standpoint and often limited to a consideration of the 'late-modern' – tends to place too much emphasis on the technical vulnerabilities of infrastructures as well as preparedness strategies underlined by the worst-case scenario, that of smart urbanism – largely viewed as originating in the private sphere – is prone to overplaying the novelty, smoothness and immateriality of digital technologies, and uncritically presuming that such technologies make cities 'better'. Over the course of the chapter, both of these perspectives will be outlined and critiqued in an effort to lay the path for a theoretical framework that oscillates between and exceeds them.

Contrary to the view that resilience-thinking represents a surrender to the chaos of radical contingency, I will argue that it is productive of new forms of knowledge designed to enable action under conditions of radical uncertainty. Furthermore, I will claim that resilience,

whilst often discussed in the context of late-modern systems, 'critical infrastructures' and counter-terrorism, cannot be disembedded from pre-existing ways of governing. To this end, the chapter re-articulates the Foucauldian conceptual apparatus set out by Collier and Lakoff (2015), in which they supplement Foucault's two primary forms of collective security – sovereign state security and biopolitical security – with a third diagram emergent in response to late-modern infrastructural uncertainties: that of 'Vital Systems Security' (VSS). All three of these diagrams will be retraced in order to examine the continuities and discontinuities amongst them. Specifically, this will help to identify two key weaknesses in the notion of resilience relative to infrastructure: first, that, in categorising different 'systems', there is a tendency to conceive of them as static, settled (albeit interdependent) wholes, when in fact they are constituted from imbrications of a multitude of circulations.[2] Second, that, in focusing on the technical complexity of such systems, we forget the social (including spatio-temporal) complexity with which they are always imbued (Dunn-Cavelty & Kristensen, 2008; Coward, 2018).

Although late-modern threats are usually conceived as technical in nature, they, like those of the other diagrams, are founded upon anxieties of a socio-political character – in particular,

[2] In this manuscript – particularly in its early chapters – I tend to talk primarily of 'circulation(s)' rather than 'mobilities'. It is important to recognise the differences between these terms and the rationale for discussing one rather than the other. First and foremost, the choice to deploy the concept of circulation derives from the fact that, in large part, this study examines a managerial perspective. Circulation is, I feel, better suited to speaking about this perspective because it relates more to models, ideals, or at the very least to systems (even if such systems are always imperfect and unreliable). For instance, where Foucault talks about circulation, this is a way of thinking exemplified by the vision of the town planner. The flows of the population are imagined through the metaphor of the cardiovascular system, leading to the model of the town in the shape of a heart, and so on. At points later in the manuscript it may appear that I use the terms circulation and mobility interchangeably. This is not intended to undermine the crucial differences between the concepts. Nor is it intended to dismiss the kinds of power relations at the heart of the mobilities literature – the complex relations between the relative mobility of some and the relative immobility of others. Instead, it should serve to indicate to the reader the trickiness of logistical power, the ways in which, by mediating between tactics and strategy, it creates the impression of a system (of circulation) inclusive of, responsive to, and cooperative with every one of its parts, every one of its constitutive mobilities – 'every journey matters', as another TfL slogan goes. As such, where experiences of mobility are later discussed, these remain primarily (if not exclusively) experiences as they are imagined or intended by governing agencies. To be clear, this is not to say that such intentions are 'successful' in any final or complete sense, but that they are relatively effective in concealing or mediating the exclusion and marginalisation they at the same time produce.

anxieties of demodernisation concerning the *disruptive excess* inherent to urban life. Even prior to their massification and abstraction into systems, circulations were deemed a particularly acute problem which drew the attention of liberal regimes because of both their role in the accumulation of capital, and their potential for giving rise, unpredictably and without warning, to events which could threaten the very foundations of society. The oft-referenced notion of 'cascading failure' must therefore be recognised as a socio-political as well as a merely technical possibility. From this broader perspective, one can elaborate on the contemporary political stakes of infrastructure and its potential disruption. What, from one angle, is a cascading failure, is, from another, a tool for amplifying political claims. The politics of infrastructure, said to lie dormant in times of normal functioning, is revealed by, but also performed through, moments of disruption.

The next section of the chapter will contextualise these ideas in relation to emergency governance in the UK, exploring the form(s) of knowledge produced alongside the ontology of complexity, and the factors which sparked this shift in perspective. Taking the Civil Contingencies Act 2004 (CCA) as epitomising the UK's resilience-based approach, it is argued that this act and the institution from which it came – the Civil Contingencies Secretariat (CCS) – were heavily influenced by domestic events characterised by a failure to contain disruption to a manageable scale, resulting in considerable economic and political damage and disorder. The approaches devised in relation to these disasters therefore sought to reclassify emergency as an 'interval' in which action is possible and indeed urgently necessary in order to intercept disruption, preventing its spread and the event's slide into catastrophe (Anderson & Adey, 2011).

Following up on Anderson's (2012) notion of 'rapid response', together with other analyses of pre-emptive or anticipatory ways of knowing, the chapter probes these contemporary

forms of emergency governance further, asking whether they might warrant a re-evaluation of Collier and Lakoff's conceptualisation. In particular, the emphasis of VSS on enactment as the means by which the vulnerabilities of systems are compiled, juxtaposed, and calculated might be supplemented by processes which act more iteratively, within the event as it unfolds. These kinds of response tend to be associated with technologies which allow for the continuous and near-instantaneous communication of information between the (human and non-human) circulatory components of systems, thus bringing to the fore the place of 'smart urbanism' in enhancing the resilience of infrastructures by rendering them more flexible and adaptable. Notably, the aim of such techniques is to allow what was previously conceived separately as emergency response to be more fully absorbed into everyday procedures; into the 'normal functioning' of the system. The workings of these processes express nicely the tension between resilience-thinking and smart urbanism; they appear to pull both in the direction of the everyday, the small-scale, the dispersed, and, at the same time, in the direction of integration, centralisation, and the possibilities of control. The chapter will conclude by asking what theory might account for this tension, paving the way for the exploration of logistics in chapter two.

1.2. Resilience and its Discontents: The End of Security?

In a 2017 publication issued by the House of Commons on preparedness for a chemical, biological, radiological or nuclear (CBRN) incident, the UK's then-Minister of State for Security Ben Wallace gives a frank assessment of the country's security outlook:

> "We have to be honest with the public that we cannot cover every eventuality in every square centimetre of this United Kingdom. We are informed by intelligence and we are informed by risk…It is my responsibility, the Home Secretary's and the Prime Minister's, to have to say 'Here but not here', or 'This service here but not here'. That is what we have to do" (House of Commons, 2017: 18-9).

Dismissing the premise of 'absolute protection' upon which security claims have traditionally been based, Wallace admits that the role of government in the current situation is that of prioritising certain 'here's over others, based on an assessment of their relative risk and attention to "value for money principles" (ibid.: 18; *see* Kristensen, 2008). Such a perspective reflects the importance of *risk* as a technique for informing security policy in liberal societies. A product of the necessity to "square the circle" between the interests of the security state and those of commercial enterprise (with its attendant circulations of things, people, and information), risk is intended to ensure that security measures are proportionate, whilst at the same time encouraging private actors to consider the risks to which they are exposed and put in place their own procedures to mitigate them (Kristensen, 2008: 70).

Adherence to risk is borne out in the UK context by the National Risk Assessment (NRA). Carried out annually, and accompanied by a publicly available version published by the Cabinet Office ((the National Risk Register - NRR), the NRA identifies 'critical assets' – including physical sites, as well as particular networks and processes – in need of protection (Brassett & Vaughan-Williams, 2015: 39-40). Possible threats are ordered through a classical risk matrix, ranking the plausibility of a risk occurring in the next five years against its 'relative impact score' (*e.g.* Cabinet Office, 2015a: 12). And yet the category of risks to be prepared for exceeds the bounds of the matrix. Though the NRA, for instance, includes only those risks which are assessed to have at least a 1-in-20,000 chance of occurring within the five year period, there is a further document, owned by the Home Office, which is marked at a higher classification and contains a wider range of possible, albeit highly unlikely, scenarios (House of Commons, 2017: 16). This slippage between the (relatively) constrained risk assessment and its nebulous appendices is indicative of a shift identified across both the

physical and social sciences in recent years; the shift away from or beyond risk, and towards complexity and resilience (Chandler, 2014a; 2014b; Heath-Kelly, 2015).

Complexity, Resilience, and the Problematisation of Risk

Complexity theory, predicted by the late Stephen Hawking to be *the* science of the Twenty-First Century (*cited in* Evans, 2013: 71), problematises classical risk by suggesting that, as a result of the complex interdependencies of contemporary existence, linear forms of knowledge and prediction lose the authority they once held, constantly undermined by the growing prevalence of unintended consequences and non-linear, emergent events (Chandler, 2014a; 2014b). The complexity of cities and thus their vulnerability, especially in the post-industrial Global North, is linked to the density and interdependence of urban infrastructures. Particularly influential here is Ulrich Beck's (1992a; 1992b; 1994; 1996) 'risk society' thesis, which posits that we have entered into a 'second', 'reflexive' modernity wherein modern technological developments, previously hoped to alleviate us from danger, have in fact given rise to new, more nebulous and less easily identifiable kinds of risk. The complexity of technical systems is central to this conception due to its tendency to induce 'normal accidents' (Perrow, 1999 [1984]) and 'cascading failures' (Little, 2010). At the same time, these characteristics make such networks attractive targets for malign actors seeking to disrupt liberal societies (Dunn Cavelty & Kristensen, 2008).

One of the primary responses to this situation on the part of those charged with devising long-term security strategies has been a so-called 'resilience turn' (Coaffee, 2010; 2013). The PREPARE strand of the UK's counter-terrorism strategy, CONTEST, is typical of the increased onus put upon resilience. Differing from the other three accompanying strands, all of which work (at various time-scales) to prevent the occurrence of an attack, the stated purpose of PREPARE is "to mitigate the impact of a terrorist attack *where that attack cannot*

be stopped. This includes work to bring a terrorist attack to an end and to increase our resilience so we can recover from its aftermath" (HM Govt., 2011: 13. Emphasis mine). PREPARE thus works with a different temporal framework to other areas of CT policy, operating across the unspecified future event, simultaneously before, and in the aftermath of, its occurrence. Rather than a strictly linear conception of time, what this policy proposes is an orientation towards the event-ual; the potentially endless recurrence of the event and our need to prepare for and recover from it in perpetuity (*see* Massumi, 1998). Resilience thus refers to the ability (of a material, an individual, a community, a business, a system, etc.) both to absorb and 'bounce back' from shocks, and, furthermore, to learn from and adapt to or with disruptive challenges (Joseph, 2013: 38-9).[3]

As the example above suggests, the resilience turn is frequently associated with the post-9/11 environment, wherein the unpredictable and indiscriminate methods of the so-called 'new terrorism' (Laqueur, 1999) impose a radical uncertainty upon daily life in the liberal world. However, resilience is by no means a way of thinking restricted to CT. According to Chandler in fact, 'resilience-thinking' represents a profoundly different way of conceiving of the task of governance as a whole. Although its origins are usually located in ecological science (*e.g.* Holling, 1973; *see* Bourbeau, 2013; Joseph, 2013), it has for him become a broader ontology; a conceptualisation of "the being of being" based upon the 'fact' of general complexity (Chandler, 2014a: 46-52). Key to this worldview is the non-anteriority of meaning, a condition whereby regardless of the presence of knowable historical factors – the record of previous events – the emergence of the event is more than the sum of its *pasts*; it is qualitatively distinct (ibid.; Chandler, 2014b: 50).

[3] As Joseph (2013: 38) explains, the former definition relates primarily to engineering resilience, whilst the latter, more dynamic definition comes from studies of ecological or socio-ecological systems (*see also* Walker & Cooper, 2011).

In the UK context, resilience has been particularly influential in transforming emergency planning, preparedness and response over the last two decades. Perhaps the most significant piece of UK legislation in this shift is the Civil Contingencies Act 2004 (CCA, or 'The Act'), produced by the Civil Contingencies Secretariat (a branch of the Cabinet Office itself established only in 2001) as a means to formalise the definition of emergency and the duties of actors across public and private sectors of society in preparing for and responding to emergency situations. In Part (1), the CCA defines emergency as:

> "(a) an event or situation which threatens serious damage to human welfare in a place in the United Kingdom,
> (b) an event or situation which threatens serious damage to the environment of a place in the United Kingdom, or
> (c) war, or terrorism, which threatens serious damage to the security of the United Kingdom." (Cabinet Office, 2004: 1)

In relation to section (1) (a), the Act specifies in Part (2) that "an event or situation threatens damage to human welfare only if it involves, causes or may cause:

> (a) loss of human life,
> (b) human illness or injury,
> (c) homelessness,
> (d) damage to property,
> (e) disruption of a supply of money, food, water, energy or fuel,
> (f) disruption of a system of communication,
> (g) disruption of facilities for transport, or
> (h) disruption of services relating to health" (ibid: 1-2)

The Act has been said to express resilience-thinking above all because – as evident particularly in sections (1) (a) and (b) of the above definition – it institutionalises a way of conceiving and dealing with emergencies in terms of their effects rather than their specific causes (Aradau, 2010; Anderson & Adey, 2012). The 'effects-based' or 'all-hazards' approach marks a departure from even the slippery assessments of risk in the NRR and its

supplementary documents by proposing that we leave notions of likelihood behind altogether. Instead, the Act "produces a legal version of emergency based on the generic consequences of a potentially infinite set of events" (Anderson & Adey, 2012: 28). Since causes are irrelevant except with respect to the range and scale of effects they produce, one's imagination is the limit. The question of whether we're ready for alien invasion or zombie apocalypse, queries previously laughed off, now acquire a strange legitimacy as the basis for thought experiments and rehearsals within emergency planning departments. Whether the pandemic comes in the form of an army of the walking dead or a particularly resistant strain of flu, the possible consequences will be similar: fatalities and injuries, movements of people away from effected areas, an incapacitation of the workforce, the contamination of the water supply, and so on (*see* ibid).

There are two initial criticisms which have been made of resilience-based approaches to security policy. First of all, it is contended that such a mode of thought represents a form of surrender, a relinquishing of human agency in the face of radical contingency. The work of Chandler is the most obvious representative of this view, suggesting that resilience-thinking in its current guise means that "we no longer have the sense of a capacity to choose our own ends" (2014a: 189). Addressing his critique to policy-makers and theorists alike, Chandler accuses them of turning the art of government and the art of criticism respectively into the art of *being governed by; being critiqued by*, contingency (ibid: 51; 187-98). What is at stake here is the very notion of freedom. Whilst we are freed from fate, from *telos*, it may be argued that this is freedom only in the perverse, passive sense that 'anything can happen'. In place of the tyranny of destiny, we are faced with the tyranny of what Hegel called the 'spurious infinite'; of one thing after another (2015 [1816]: 139).

While Chandler's argument operates at the species level, there is a second, related criticism which shifts the focus onto the unequal relations of power *amongst particular* (groups of) humans. This is the concern that, in imagining the future as an infinite series of potentially threatening events which may happen *at any time*, *anywhere*, and *to anyone*, the contentious politics of security is conveniently denied. On the one hand, this obscures the principle of responsibility as a way of holding certain people to account; on the other, it dilutes the possibility of *solidarity* as a means to resist; to assert the voice of the small, the dispossessed, the weak, against the interests and orders of the hegemonic. As Ewald (1993 [1986]: 223) puts it, resilience's preoccupation with rescue, repair, and the resumption of activities lends itself not to "the logic of responsibility", but rather to "an enlarged solidarity, on the national and international levels, in relation to which the concept of fault is meaningless".

Resilience-thinking thus threatens to pose a simplistic binary: it is 'us' set with the task of coping with 'it': with the 'ontology of emergency' in which we find ourselves (*see* Duffield, 2012). Emergency becomes the basis of identity; the event against which we judge ourselves and others. In a further example of resilience's influence on UK policy, the *Strategic National Framework on Community Resilience*, issued by the Cabinet Office in 2011, marks out four relevant conceptual communities. The first three of these identities – 'geographical communities', 'communities of 'interest'', and 'communities of supporters' – do not strike us as particularly unusual; they are communities built around shared histories and memories, as well as shared visions of the future. The fourth group identified by the document, however, is something we are not so used to seeing. Dubbed 'communities of circumstance', these are identities "created when groups of people are affected by the same incident, such as a train crash" (Cabinet Office, 2011a: 12). Despite undoubtedly also involving shared memories, histories, and interests, communities of circumstance are distinguished by their formation through a single, often traumatic event, and consequently by their potentially

universal character. We need only look at recent events to realise that emergencies, as unpredictable as they might seem, are a product of, and/or manifest themselves through the unequal distributions of power across society. However, by supposedly cutting across any and all societal markers (race, class, gender, sexuality, age, and so on), the resilient community opens up the possibility of the emergency as a great equaliser; a source of mass consensus. With differences in exposure flattened to a plane of catastrophic vulnerability *in potentia*, all subject positions collapse into a generalised 'accident-form', a congregation "joined in fear" (Massumi, 1993:24). As Graham (2010a: 22) points out, such a stance perpetuates Konvitz's (1990) 'myth of terrible vulnerability': a universal 'We' obfuscating the extent to which certain 'Theys' succeed in reducing or mitigating their exposure. There is, therefore, a clear danger that through resilience-thinking solidarity is depoliticised, relegated from a conscious force for change into an automatic property of being. In short, "[r]esilience, in contrast to something like resistance, implies the acceptance of the situation" (Joseph, 2013: 262).

As such, it is argued that we must continue to attend to questions of inequality. Isabell Lorey (2015) for instance, draws on the work of Judith Butler (2004; 2009) to distinguish between 'precariousness' and 'precarity'. Whilst precariousness is our shared vulnerability, "a socio-ontological dimension of lives and bodies…inherent to both human and non-human being", precarity, on the other hand, is "a category of order…[which] denotes the striation and distribution of precariousness in relations of inequality" (Lorey, 2015: 11-3). Thus, although precariousness is an ontological fact from which none of us can escape, this does not preclude the possibilities of precarity; attempts by some to reduce the extent of their precariousness relative to others. Moreover, Lorey argues that "[p]recarity can therefore be understood as a functional effect arising from the political and legal regulations that are specifically supposed to protect against general, existential precariousness" (ibid: 14). In

other words, policies of resilience emphasising the impossibility of security may themselves act to make possible the order of precarity by denying the potential for some to secure themselves better than others.

More broadly, Charlotte Heath-Kelly (2015) argues that resilience obfuscates questions of responsibility and the possibility for radical change through its preoccupation with 'moving on', rapidly integrating past events into a positive narrative of learning and character-building which puts us in a better position to deal with future shocks. Here Heath-Kelly sees the disappearance of failure and of its 'visceral' sites, as a result of which pause, reflection, and critical questioning are largely supplanted by reviews outlining 'learning opportunities' in relation to a future ambition to 'fail better', marking the dominance of a discourse that is forward-looking, but not in a transformative sense; a 'post-political' stance characterised by a paradoxical commitment to the *change of no change* (*see* Swyngedouw, 2010: 219; Evans, 2013: 74-5).

Despite the apparent omnipresence of resilience-thinking, it is questionable whether such a perspective entirely replaces the logic of risk, or efforts to govern by anticipating the events of reality. The next sub-section therefore examines a number of knowledges which seem to contest the ontology of surrender sometimes attached to resilience.

Risk's Remainders: Precaution, Enactment, and Pre-emption

Rather than presenting resilience as an uncontested ontology, we might be more sensible to examine it in its performance (Brassett & Vaughan-Williams, 2015: 33-5). In doing so, it becomes clear that purported movements *beyond* – beyond risk; beyond security – are less definite than they first might seem. Rosenow (2012: 532), for example, draws attention to "the number of governmental discourses and practices in which the 'old' order of the real, an order that expresses the desire for predictable management that has clearly controllable

effects, is stubbornly persistent". Although admitting that socio-ecological systems are "inherently unpredictable", she argues that resilience theorists still believe in the capacity of knowledge-discovery to "increase…the degree of predictable change" (Ibid: 538). In a similar vein, O'Malley (2010: 488) proposes that, rather than supplanting risk altogether, resilience joins it "as part of a diverse security assemblage organized around imaginaries of increasingly uncertain and potentially traumatic futures". As demonstrated by Wallace's quote at the beginning of this chapter, risk on the whole is by no means an outdated concept. Rather, it would be more accurate to say, following Collier (2008), that particular means of calculating risk have lost the authority once invested in them. Specifically, the "calculative rationality" known as 'archival-statistical risk', which assesses the likelihood of something happening in the future based upon the frequency of its occurrence in the past, has been largely replaced by a hybrid approach less dependent on the linear, causal relationships between past, present, and future events (O'Malley, 2013: 185; Collier, 2008: 225). O'Malley argues that this hybrid consists of three methods which together may be characterised as 'post-risk'[4]: First of all, precaution; second, preparedness and enactment; and third, speculative pre-emption.

Precaution centres on what Ewald (2002: 287) refers to as the "duty to imagine the worst possible", that is, the responsibility, both within institutions, and at a broader societal level, to consider the potential extremes of a situation as the basis for our assessments and decisions. A precautionary approach fits neatly with the aforementioned 'effects-based' definition of emergency, since the latter creates a qualitative likeness between emergencies of all kinds (whether actual or potential), enabling them to be positioned along a single spectrum. The North American Federal Emergency Management Agency (FEMA) provides

[4] This may be considered in the same way that Derek Gregory (2004) considers the 'postcolonial'; it belongs to what it succeeds.

an apposite example in its definition of incidents along a severity scale: Emergency – Disaster – Catastrophe – Extinction (Aradau & Van Munster, 2012a: 101). The effect of such a continuum is to invest emergency with a "quality to be otherwise, to be more or less than itself as it is positioned as a phase liable to be lessened or greatened in magnitudes of urgency or seriousness" (Adey et al., 2015: 6). In other words, it suggests that, without timely and appropriate response, an event at one point on the scale can all too easily *slide* into another, more severe phase. The underlying psychological position here could best be described as one of *intentional paranoia*, the need to treat even the seemingly insignificant event as a potentially catastrophic situation in need of urgent treatment.

If precaution describes a duty to imagine the worst possible, then preparedness and enactment is the duty to model and rehearse it. As such, enactments do not often take the form of an incident which has happened previously, but are instead designed to test response to events characterised by novelty and unpredictability. This does not mean, however, that such exercises are entirely severed from the past. Rather, they make use of past events by breaking them down into their component parts, before reconstituting them in unprecedented combinations. As Collier puts it:

> "Rather than drawing on an archive of past events, enactment uses as its basic data an inventory of past elements at risk, information about the vulnerability of these elements and a model of the threat itself – the *event* model. And rather than using statistical analysis, enactment 'acts out' uncertain future threats by juxtaposing these various forms of data" (2008: 226)

Rather than a scripted play, the emergency exercise thus more closely resembles the preparation put in by a group of improv. comedians: a honing of reflexes and the *repartee* between different actors. And, rather than improving knowledge of the event itself, enactment seeks to enhance understanding of the characters and reactions of different

elements, both human and non-human. As Anderson and Adey (2012: 27) observe of UK exercises, what is intended is the simulation of events as they unfold, leading to 'wide area' emergencies which draw in a large range of agencies at various scales, from first responders and local volunteer bodies to national and international institutions.

In both precaution and enactment then, the emergency is imagined as an unfolding and potentially catastrophic event in relation to which urgent and coordinated action is required. Notably, this signifies *an inversion of precaution's traditional relationship to uncertainty*, from a passive to a much more proactive stance. Instead of waiting to act; carefully considering one's options so as to ensure you (to borrow a medical turn of phrase) 'do no harm', precaution here endorses the urgent need to act in order to minimise potentially catastrophic damages. This inversion is fully-realised by the third and final 'post-risk' approach identified by O'Malley; that of speculative pre-emption. Characterised by the idea that action is necessary precisely *because of* the absence of certainty (2013: 187), speculative pre-emption distinguishes itself from predictive methods by acting on the event in its emergence. Louise Amoore, for instance, has examined the function of the 'data derivative' and algorithmic ways of knowing as a pre-emptive technique for acting in conditions of radical uncertainty. Rather than attempting to establish causality between one piece of data and another, "contemporary risk calculus…works instead on and through the *relation* itself", using "processes of data integration, mining and analytics [to] draw into association an amalgam of disaggregated data, inferring across the gaps to derive a lively and alert new form of data derivative – a flag, map or score that will go on to live and act in the world" (2011: 27). Because it acts on the relations between emergent data, such ways of knowing can produce the basis for action without needing to rely on archival-statistical datasets. As Amoore puts it, "[w]hat matters" is not the ability to use the past to predict what will happen in the future, but instead "the capacity to act in the face of uncertainty, to render

data *actionable*" (ibid.: 29). The nature of the calculation thus lies in the visualization of the speculative composition of data on the screen, not as a decision or judgement but rather as a set of instructions to be followed (ibid.: 34). Addressed to preparedness, this approach comes to mean that every potential event must be rendered actionable in advance. It thus necessitates not just imagination and enactment, but also *the development and normalisation of formal structures and mechanisms, informal arrangements, forms of knowledge, and technologies by which response to the emergent event can be made more fluid and more effective* (see Anderson, 2012).

Through O'Malley's conceptualisation of 'post-risk' it is possible to see that, as opposed to any kind of surrender to uncertainty or insecurity, the resilience turn involves an uncomfortable, but nonetheless workable, co-existence of two discourses: one emphasising the idea that events are radically unpredictable; the other proposing that they may nonetheless be managed and secured. For instance, in spite of its characterisation of emergency as an unpredictable event positioned on a sliding scale, the intention of the CCA is simultaneously to frame emergency as an 'interval' in which, as opposed to catastrophe or disaster, "action is demanded and promises to make a difference" (Anderson & Adey, 2012: 26; 2011; Adey et al., 2015). As Adey, Anderson and Graham (2015: 10) point out, the production of emergency exercises likewise feeds off "[t]emporalities other than the apocalyptic…that produce particular space-times in which possible futures are brought into the present". In a similar fashion, pre-emptive approaches, while certainly mobilising catastrophic imaginaries, also act through forms of response which propose the emergency as an actionable (if not necessarily controllable) situation. Emergency is therefore imagined as a specific temporality at which "[l]ife is tensed at a threshold…between a return to normality, even if it is a normal life on the verge of emergency, and a descent into a disaster that threatens to destroy something valued" (Anderson, 2012). This threshold, by

constituting emergency as an unspecified time period consisting of an "intensified present"; a 'within', presents the opportunity to intervene while at the same time conjuring frightening images of what might happen should we fail to do so with sufficient speed (Anderson & Adey, 2012: 29). Evans furthermore marks out this point – "the point at which everything has already happened, while everything is going to happen" – as "the intersection where security agencies now enter" (2013: 172). As such, we may ask what form this entrance takes. How do security agencies insert themselves into the within of the emergency?

Rapid Response

There is a straightforward answer to the above question: cued by the apparent ubiquity of the 'rapid onset disaster', security actors (both public and private) are honing their capabilities towards 'rapid response' (Anderson, 2012). For Anderson this approach is exceptional not in the Agambenian (1998; 2005) sense – as a sovereign suspension of the law – but instead with regard to its speed. As Anderson puts it: "To ensure that an emergency situation does not cross a threshold and become a disaster, an emergency must be met as it emerges" (2012: n.p.). Rapid response thus requires, not the "temporary 'suspension' of normal rights", but rather "the automation of exceptional but constitutional action through flexible, intersecting, protocols that govern how things should be done in response" (ibid.). This process of 'automation' and acceleration is evidently not a surrender to contingency, but rather the development of new forms of knowledge and practice capable of operating within the condensed time-space of emergency. A key set of questions here stems from the initial and general query: how is this made possible? What technologies or arrangements allow for rapid and flexible response, and what are the political consequences of such arrangements?; "what political problems are rendered intelligible…and what problems are obscured?" (Collier & Lakoff, 2015: 46; Amoore & Raley, 2017). As we will see, the imperative for rapid response tends to place growing

importance upon 'smart', 'real-time' technologies of communication, monitoring and calculation which in turn suggest the growing involvement of corporate rationales in urban and infrastructural governance. Yet this is only one side of the coin. Following those who have drawn attention to the affective aspects of emergency governance, I would like to contend that rapid response involves not only knowledges and representations, but also spatio-temporal, material and sensory forms of expression.

Before we begin to investigate these issues in more detail, it is necessary to justify our project; to ask why the governance of infrastructure is a political issue in the first place, and what the possible consequences of resilience approaches might be for the politics of the urban as a whole. There are multiple perspectives which could reasonably be taken up here. Like Agamben, we might examine the politico-legal ramifications of an exceptionalism which has become a liberal, democratic norm; alternatively, from a comparative point of view, we could examine the similarities and differences between how resilience and rapid response are deployed (or not) in different societies, and relate this back to historical, political or cultural factors.[5] However, the perspective pursued in this case will be one underwritten by the conceptual and historical relationship between governance, especially urban governance, and circulation (together with its negative, disruption). The main reason for making these concepts central to my reading is that, as will be made clear in the following section, the contemporary concern with rapid onset events and the consequent turns towards resilience and rapid response stem from deeply embedded concerns around infrastructural systems whose function for society – especially urban society in the heavily developed global north – is to facilitate continuous and coordinated circulations of things, people, and information through space. Rather than an entirely novel phenomenon linked to the technological

[5] It has been suggested for instance that resilience is an idea particularly well-suited to British culture (Joseph, 2013).

complexity of late-modernity moreover, the anxiety of disruption spans the histories of state and city, stimulating the creation of successive forms of knowledge with which to calculate and govern flows and their disorders.

In the following section, we consider the association usually made between the vulnerabilities of the urban, and the concepts of 'risk society', 'Critical Infrastructure Protection', and 'Vital Systems Security'. Whilst the last of these ideas is especially useful in that it brings a much-needed governmental perspective to the study of infrastructure, it is nonetheless seen to underplay both the socio-political uncertainties involved, and the role of mechanisms of response.

1.3. Risk Society, Critical Infrastructure, and Collective Security

As opposed to a nation in wartime; its frontiers under attack from external enemies, the uncertainty to which resilience and rapid response approaches are a repost is admitted to come, at least to some extent, from within; from the nature of liberal society itself. For instance, the oft-quoted introduction to the UK's 2010 National Security Strategy claims that the country's vulnerability comes from the fact that "we are one of the most open societies, in a world that is more networked than ever before" (HM Govt., 2010: 3). As previously mentioned, vulnerability is thought to result specifically from the complexity and interdependence of infrastructures (Graham, 2010a; Little, 2010), thus echoing Ulrich Beck's (1992; 1994) famous 'risk society' thesis. As Beck himself describes it, the emergence of risk society is tied to "[a] phase of development of modern society in which the social, political, ecological and individual risks created by the momentum of innovation increasingly elude the control and protective institutions of modernity" (1996: 27. *Quoted in* Coaffee, 2009: 68. *See* Giddens, 1991; Collier, 2008; Collier & Lakoff, 2015: 21).

In the UK and elsewhere, this has led to the formation of new objects-to-be-secured – 'Critical Infrastructure' (CI) and 'Critical National Infrastructure' (CNI) – through programmes of 'Critical Infrastructure Protection' (CIP) which seek to assess the vulnerabilities of infrastructures, and to enhance their resilience against disruption. Critical infrastructure – defined as "the basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons" (Moteff & Paformak, 2004: 1. *Quoted in* Steele et al., 2017: 76) – has thus come to the forefront of security policy. Claudia Aradau (2010: 491) for instance points to the European Commission's (2004) classification of infrastructure protection as one of the key duties of state responsibility for the present time – supplementing the protection of borders and the protection of citizens. In the UK, similarly, both the 2010 and 2015 National Security Strategies (NSS) have placed considerable emphasis on both infrastructure in general and CNI specifically (HM Govt., 2010; 2015; Cabinet Office, 2011b).

Aradau additionally observes how, through these changes, "things and their material connectivities have become instrumental in the understanding of what it means to secure societies against terrorist attacks and other risks and hazards" (2010: 491-2). It is the density of these things and their connectivities, particularly in urban areas, which contributes specifically to the aforementioned 'intentional paranoia' of contemporary emergency. Such systems are 'tightly coupled' and 'complex' in Charles Perrow's (1999) sense, and are therefore susceptible to so-called 'cascading failure': "a situation where an infrastructure disruption spreads beyond itself to cause appreciable impact on other infrastructures, which in turn cause more deleterious effects on still other systems" (Little, 2010: 29). The meaning of 'criticality' in classifications of critical infrastructure is thus derived not just from the notion of importance but, like the patient in *critical condition*, from a certain negative

potential thought to be inherent to such systems (*see* Steele et al., 2017). The connections which in times of normal functioning act as regulated routeways, can all too easily be subverted into vectors of threat, allowing incidents to spread and evolve.

Despite the radical unpredictability of the cascading failure, infrastructure is again not surrendered to contingency but instead subjected to new forms of knowledge. For example, Collier and Lakoff (2008; 2015) see CIP as part of a wider form of governmentality which they call 'Vital Systems Security' (VSS), characterised by an understanding of "collective life as dependent upon a complex of critical systems that are vulnerable to catastrophic disruption" (2015: 20). VSS is argued to be evolved out of, but distinct from, the two diagrams previously identified and described by Foucault in his lectures at the College de France: the 'sovereign state security' of the 17th century, and the 'biopolitical security' of the 18th and 19th centuries (Foucault, 2007; 2008). Whereas the former emphasised the security of the state itself against both external and internal enemies, and the latter "the health and wellbeing of national populations" (Collier & Lakoff, 2015: 21) enabled through the construction and regulation of infrastructure projects, VSS is described as a 'reflexive biopolitics', arising out of the need to attend to the hazards created by the modern biopolitical mode of security itself. VSS was, in other words, a response to a moment at which "the very instruments of biopolitical government, which aimed to foster the health and wellbeing of the population, came to be seen as potential sources of vulnerability" (ibid.).

This conceptualisation is notable in its conscious departure from theories (such as Beck's) that present late-modern risks as uniquely incalculable, instead seeking to trace the "new security mechanisms designed to assess the vulnerability of vital systems and to ensure their continued functioning" (ibid.: 22; Collier, 2008). In so doing, it separates out the different

'forms of knowledge' with which each form of security is associated: sovereign state security with *raison d'état*; population security with the social sciences; and VSS with 'system-vulnerability thinking' (Fig. 3). Despite this distinction, Collier and Lakoff caution that this is "not meant to present a succession of historical stages", and that, "[a]lthough it is possible to trace the emergence of these forms of collective security to specific historical moments, each did not replace prior forms but rather arose in complex relation to them" (2015: 22; 24). Below, I will address this critique to their own theory in order to highlight some of the continuities running through the three different forms of security they mention. Firstly, this is intended to show that earlier forms of governing were not exclusively based upon a belief in linear, predictable events, but were in fact concerned with the radical unpredictability of the social. As such, the second aim is to emphasise that the 'late-modern' risks associated with CIP and VSS, though they appear heavily technical, are in actuality founded upon deep-seated socio-political anxieties. Finally, it serves to demonstrate that, despite the crucial importance of preparedness, there remains room to elucidate the nature of response itself.

		Biopolitical Security	
Form of Collective Security	*Sovereign State Security*	*Population Security*	*Vital Systems Security*
Moment of Initial Articulation	17th century: absolutist states	19th century: social insurance, public health	Mid-20th century: nuclear preparedness
Aim	Strengthen and secure sovereignty against internal and external threats	Manage regularly occurring threats such as endemic disease, poverty, and infirmity	Secure the functioning of systems that are essential to modern life in the face of unpredictable but potentially catastrophic threats
Object of Concern	Bases of sovereign power: military strength, internal order, wealth	Social processes: economic production; circulation or exchange of goods and people; demographic processes	Vital systems: webs of industrial production, critical infrastructures, governmental apparatuses
Form of Knowledge	*Raison d'etat*: knowledge about balance of power, domestic bases of sovereign power	Social sciences: knowledge about the regularities of collective life such as rates of birth, death, employment, poverty and crime, and economic cycles	System-vulnerability thinking: knowledge about interdependencies and vulnerabilities of vital systems
Characteristic Apparatuses	Diplomatic and military measures to increase internal and external security; mercantilist policies to increase sovereign wealth	Social insurance; infrastructure development; macro-economic management; public health; urban planning	Governmental preparedness; vulnerability reduction; emergency management

Figure 3: Forms of Collective Security (source: Collier & Lakoff, 2015: 23)

Raison D'État: Ontological Security and the Immanence of Catastrophe

> "Anxiety for the future time, disposeth men to enquire into the causes of things: because the knowledge of them, maketh men the better able to order the present to their best advantage"
>
> (Hobbes, 1968 [1651]: chap. 11, 167. *Quoted in* Frost, 2010: 163)
>
> "modern politics is a security project in the widest possible – ontological – sense of the term"
>
> (Dillon, 1996: 14)

Claims to the novelty of unpredictable times tend to underestimate the extent to which the modern state crystallised in response to the scourge of uncertainty. As is well-documented, security lies at the base of the modern state's formation, the classical Weberian and

Hobbesian theories of sovereignty stating the need for the interior of the state to be incubated from an outside characterised by anarchy and disorder (*see* Kristensen, 2008; Lorey, 2015: 10-11). It is worth noting however that this process was psychological as much as it was physical. It intended to secure the population against a sense of pervasive and radical uncertainty. To use Anthony Giddens' term, the practice of state formation looked to ensure the 'ontological security' of the nascent polity, establishing a kind of 'basic trust' which "allows the individual to sustain hope and courage in the face of whatever debilitating circumstances she or he might later confront" (1991: 39).

Relatedly, Frost argues that Hobbes was well aware of the inescapably volatile nature of existence, believing that, although "all events and actions are caused", "each has a broad array of causal antecedents that are related to one another in a complex, nonlinear fashion" (2010: 160). The heteronomy of action makes it almost impossible to isolate a determining factor for an event, obstructing the ability of men "to order the present to their best advantage" – to ascribe solutions; to act with a sense of meaning. Rather than a purely repressive state therefore, the Hobbesian Leviathan may be understood with greater nuance as an idea which arose as a means of coping with this reality, a construct onto which feelings of anxiety for the future could be focused and thus regulated. Seen this way, the effect of the sovereign's power would be to narrow the causal field, transforming generalised anxieties into fears with a finite range of possible causes, giving us the (false) impression of order – "a sense of 'unreality'" (Giddens, 1991: 40) – and allowing us to "foster an illusion of autonomy so that we can *feel* effective when we act" (Frost, 2010: 160; 169). A further derivative of this interpretation is that physical and ontological security are not complementary goods. In fact, where an instance of physical *insecurity* means the attribution of anxiety (as fear) to a known risk, this works to bolster ontological security by bracketing off other possibilities (Mitzen, 2006).

Following this set of ideas, the early-modern state's form of knowledge, *raison d'État*, can be considered as an attempt to ensure ontological security through means not dissimilar to contemporary resilience approaches: by building the state's capacity to anticipate and recover from the effects of harmful events. As Foucault puts it, "what is involved [in *raison d'État*] is essentially identifying what is necessary and sufficient for the state to exist and maintain itself in its integrity *if, in the event of it being damaged*, it is necessary to re-establish this integrity" (2007: 258. Emphasis mine). The presence of the 'if' marks for us the orientation of the modern state, from the outset, towards the fending off of its possible demise. In order to proceed to exist, government must concentrate its efforts on this constant possibility. Without doing so; without "being reviewed at every moment and maintained by an art of government assured by *raison d'État*", "the republic would not survive for a moment and would have no continuance" (ibid.: 259). We get a sense from Foucault's writing here as to the urgency of *continuity* and *vigilance* for the modern state, an art of government that is reflexive in a pessimistic sense, that is, perpetually attuned to catastrophe. A single lapse in the state's efforts to reproduce and protect itself, and it might cease to exist.

But what is the state trying to protect itself *against*? What is the source of catastrophic possibility? It is – and here is the really reflexive part of *raison d'État* as Foucault sees it – the people themselves, and the immanent potential for revolt they carry within them. Contrasting Machiavelli's infamous treatise on power, *The Prince* – written in the context of conflict among the fragmented territories of Italy – with Bacon's later (1999 [1625]) essay 'Of Seditions and Troubles', Foucault argues that, while the former located the main source of threat to the sovereign in the malign intentions of rival members of the nobility, in the latter "[w]hat is evoked instead is a sort of constantly present possibility within the state that in some ways belongs to the daily life of states, or at any rate belongs to the intrinsic

virtualities of the state. This 'virtuality' is sedition and riot" (2007: 271; Dillon & Reid, 2009). Despite the apparent novelty of risk associated with late-modern, complex and interdependent systems, it was because of this initial concern with the complexity of socio-political life that the state first looked to infrastructure as a set of connected objects integral to the maintenance of political and economic order. It is here worth quoting at some length from Dillon and Reid, who assert that:

> "Liberal states of the early modern era attempted to improve the governance of the infrastructure not so much out of moral concern for the welfare of populations, however, but to secure themselves from the threat of 'sedition'. Gradually it became understood that the general improvement of circulation among the domestic population, not least in respect of the circulation of food and the avoidance of death or famine, was required as much to avoid riot and sedition as it was to strengthen the sinews of the state, as well as, relatedly, to better organize the accumulation of capital and the pursuit of profit and trade" (2009: 134)

As such, the ordering of circulations served a dual purpose, one political, helping to stave off unrest; the other economic, increasing the efficiency of movement of things and people across space. However, what is evident from Foucault's discussion of Bacon's essay in particular is that the virtuality of unrest was not something which could be easily predicted. "Seditions, [Bacon] says, are like tempests, they arise precisely when they are least expected, in the greatest calm, in periods of stability or equinox" (Foucault, 2007: 267). Rather than prediction, Bacon endorses an approach that we might describe as 'early modern pre-emption', calling for careful attention to sedition's "way of signalling", a "semiotics of revolt" (ibid.) that suggests the event in its inception. Spotting these signs depended upon making circulations known and frequently calculable – as an 'economy' – such that changes in their levels, sudden scarcities or congestions, could be quickly noted and managed (ibid.). Modern infrastructure projects were above all about channelling

circulations, making them visible as distinct sectors of an integrated economic network underpinning society. It is important to keep this initial threat to the state – and the form of response to it – in mind whilst looking to what have been identified as the modern and late-modern modes of governance.

Population Security: The City and the Problem of Circulation

The development of modern states across Western Europe from the 18th century onwards centrally involved the infrastructural question of circulation – of how to enable and encourage the efficient movement of people, goods, and information, whilst regulating the risks to which such mobilities gave rise. This was particularly associated with the space of the city, which over this period shifted in form from a self-contained fortification to become a key node in the workings of the state (Foucault, 2007; Harvey, 2003; Usher, 2014). As Foucault puts it, the crucial question was how to open up the town, "resituating [it] in a space of circulation" (2007: 13. *Quoted in* Usher, 2014: 553). Usher (2014) compares and contrasts the two answers to this question identified by Foucault: initially, the disciplinary response of the sovereign, and, emerging in the second half of the century, that of population security or biopolitics. Essentially, he argues, "discipline is applied to urban circulations of people and natural resources centripetally, to establish rhythms and enclose flows in fixed predetermined streams whilst foreclosing exchange between inside and outside" (2014: 557). It orientates circulation around the capital of the sovereign state, regulates it and calculates it, and does so with the "utopia of the perfectly governed city" in mind (Foucault, 1977: 198; Usher, 2014: 556-558). Catastrophe, according to this model, comes in the form of the undisciplined flow; a circulation which escapes its given routeway and cross-contaminates with that of another.

Population security, on the other hand, works by "allowing circulations to take place" (Foucault, 2007: 65), "creat[ing] complex networked assemblages that connect people, places and things across time and space" (Usher, 2014: 558). This approach thus seeks out the possibility of governance not through the control of circulation and its precise calculation but instead through the aforementioned mechanism of (archival-statistical) risk: by constructing an archive of past events across the population, statistical analyses could calculate an average; a normal range and its distribution according to which the future likelihood of a certain event could then be determined and prepared for (or insured against) accordingly (Collier, 2008: 227-8; Coaffee, 2009; Usher, 2014). The mechanism of risk in this sense enabled an event which had not (yet) happened to be rendered 'predictable' via its relation to a large number of past events of a similar kind (Beck, 1992b: 99; Coaffee, 2009).

Vitally, the formation of a liberal modern state – deriving its strength from the health and wealth of its population – required that government intervention be tempered, minimised to only its necessary moments. Governing through statistics and risk made this possible by providing the population with tools and measurements with which to self-govern; to prepare themselves and insure themselves (Lorey, 2015: 25; Foucault, 2008; Collier, 2008). This state depended, in other words, upon the private citizen's participation and 'responsiblisation' (Ajana, 2005); their integral role in minimising the occurrence and impact of emergencies by continuously calculating the likelihood of their occurrence, and by being aware of the measures one could take to mitigate risks (*see* Rose, 1999). As Usher makes clear, this remains at its core a problem of circulation; of how to let things circulate despite the risks this inevitably creates. The biopolitical answer is to in fact increase the degree and intimacy of engagement between the population and its circulations. In the contemporary context of Singapore's water system, Usher argues that, as opposed to "purifying circulation

in the disciplinary mode…statecraft may instead entail the exposure rather than enclosure of circulatory spaces to multiple and meaningful social interactions, to constantly calculate and imbricate complex coexistences of reticulated circulations, to facilitate more subtle forms of government aligned with that of security" (2014: 560). It is thus also through engagement with circulations that members of the population can achieve what Lorey refers to as "imaginary self-sovereignizing": the development of forms of conduct – diligence and vigilance in particular – through which they can attempt to reduce their exposure to contingency (2015: 26-7). Like fear for Hobbes, calculations of risk here enable a sense of ontological security and the basis for meaningful action on an everyday basis. According to Dillon, such methods of calculation lie at the heart of modernity as a metaphysical project of security and knowledge. Faced with a rift between the urge to know – to know what is and what will still be (in the future), to have a sense of continuity – and the inevitable uncertainty of our existence, security always resorts to calculation:

> "Because the appearance of things is inevitably various, because we ourselves always encounter them from a manifold of perspectives and because, finally, we are also mortal and fallible creatures, whatever the secure ground of things is that metaphysics seeks, it cannot actually be the sensible world of the appearance of things themselves. For they are too…well, insecure. It has, ultimately, to be supra-sensible, situated outside the realm of the appearance of things" (1996: 20).

This shift beyond the sensible will be critiqued at a later point. For now though, it serves to show how the ability of the population to "constantly calculate and imbricate complex coexistences of reticulated circulations" (Usher, 2014: 560) allows them to engage in a continuous effort to maintain a sense of the continuity of things. Their calculations provide the supra-sensible reassurance of continuity.

According to Collier & Lakoff (2015), however, mechanisms of population security have, over the course of the 20th century, been compromised by the potential for events which, working through the complexity and interdependence of vital systems, are radically unpredictable and potentially catastrophic. As well as accidental failures, such events were induced through military strategies which sought to re-purpose infrastructural connectivities, mutating the rapid circulation of goods, people and information into the rapid spread of disruption and uncertainty. As will be emphasised in the following section, this remained a socio-political as well as a technical set of concerns.

1.4. Vital Systems Security: Aerial Bombing and Anxieties of De-modernisation

> "It should be lights out in Belgrade…Every power grid, water pipe, bridge, road and war-related factory has to be targeted…We will set your country back by pulverizing you. You want 1950? We can do 1950. You want 1389? We can do that, too!"
>
> (Friedman, 1999. *Quoted in* Graham, 2010b: 116)
>
> "CRITICAL INFRASTRUCTURE IS PEOPLE!"
>
> (Lipschutz, 2008: 206)

The above quote, from the right-wing economist Thomas Friedman writing on the eve of the 'humanitarian' bombing of Serbia by NATO forces, expresses the Janus-faced nature of urban infrastructure; its ties to both biopolitics and thanatopolitics. As well as being the building blocks (or, rather, circulations) of urban life, such systems may easily become the *vectors* or *delivery systems* for campaigns of "place annihilation" (Hewitt, 1987: 464. *Quoted in* Graham, 2004: 33) or 'urbicide' (Coward, 2008). At the same time, Friedman's words position the aerial bombing of infrastructure as a strategy with the capacity to reverse linear, Rostovian models of development; not simply to destroy but to *de-modernise* enemy societies (Graham, 2010b: 116). The catastrophic concern that provides the basis for VSS is

therefore linked not only to technical failure, but also to a more broad-based set of social, political, and perhaps even moral anxieties. If infrastructure is what *advances* and *ties together* liberal society, then what is seen to be at stake here is the possibility of *reversals* and *unravellings*.

This idea can be clarified by considering the point made by Dunn Cavelty and Kristensen (2008: 4-5), who argue that CIP can be understood in either a narrow or a broad sense. From the narrow perspective, that which is often present in mainstream accounts, infrastructure is envisaged as technical in nature, a set of interrelated objects which give rise to events or hazards, and which need to be made more 'resilient' (ibid: 5). By framing CIP as a 'preparedness practice', this view tends to sidestep questions of subjectivity and power relations that are invoked in discussions of security or policing (ibid.). From a broader and perhaps more critical angle however, CIP is inseparable from such social and political issues: "[the narrow view's] ideal-type and utopian view of things is inevitably problematised, because there is no way of avoiding the intermingling with both flows and processes, with the truly virtual, and also with questions related to human subjects and the law". As such, "the objects of protection in CIP include not only static infrastructures, but also various abstract things such as *services*, (information) *flows*, the *role* and *function* of infrastructures for society, and especially the *core values* that are delivered by the infrastructures" (ibid: 11). With this in mind, CIP functions socially and politically, "as a framework for the establishment of new degrees and techniques of control over the properties and processes of life" (ibid: 5).

According to Collier and Lakoff (2015), VSS as a diagram of power is distinguished from both *raison d'État* and population security via its particular focus on *the integrity of systems*, as opposed to the former focus on the integrity of the state or the population. The emergence

of this form of governance is said to be linked to certain historical and technological developments over the course of the 20th century, in particular the (actual) targeting of infrastructure through aerial bombing campaigns, especially during the Second World War, and the (virtual or potential) targeting of those same assets with nuclear warheads in the Cold War era. Following the above discussion – together with Lipschutz's timely reminder that "critical infrastructure is people" – these moments will now be explored in more detail in order to illustrate the fact that, though coalescing around infrastructure as a technical object of protection, they were always-already infused with socio-political anxieties. More specifically, I will attempt to show that such anxieties have tended to involve, in particular, a concern with urban populations as *excessive* in nature, in need of specific forms of governance because of their inherent potential to undermine the foundations of liberal society, including the resilience of its vital systems.

The Enemy-as-a-System: Strategy, Aerial Targeting, and Preparedness

Concerns over the vulnerabilities of vital systems and the movement of infrastructure towards the centre of security projects in the US and Western Europe are seen to stem from the targeting of those systems as a key characteristic of the development of 'total war' during the 20th century. With the mechanisation of warfare in this period increased attention came to be paid to spaces beyond the immediacy of the battlefield; spaces in which the production and transportation of the materials – munitions, fuel and food – needed to mobilise for war took place (Cowen, 2014). Air strategists in particular envisaged the enemy as an 'industrial web' of production and distribution necessary for the execution of war. Accordingly, the targeting of production facilities and supply lines began to be seen as an effective way of indirectly targeting the armed forces (Graham, 2007; 2010b). Moreover, since domestic infrastructures were now envisioned as an extension of the military system, attacks on so-called 'dual-use' targets could be more easily justified as legitimate acts of war

(Coward, 2009). As the original airpower strategist, Giulio Douhet, put it: "the distinction between belligerents and non-belligerents no-longer exists now, since all are working for the war, and the loss of a worker may well be more serious than the loss of a soldier" (1951: 127. *Quoted in* Hippler, 2017: 83). Hippler (2017) argues that this targeting of civilian spaces was far from peripheral (or 'collateral') to the war effort. Indeed, he proposes that central to the strategy of aerial bombing was the intentional targeting of the working classes of a society, with the aim of stoking unrest and dissent amongst the domestic population. This form of attack sought to pick at the internal stitches of that mythic and imagined entity, the nation-state, provoking it to come apart at the seams. As Hippler claims, "[b]anking on the lack of coincidence between people and state, the air offensive aims to undo the unity of the body politic and reduce it to the status of a 'populace'" (2017: xvii-xviii). Rather than coming from the outside, then, these interventions were intended as a trigger toward a further set of effects coming from within, "releasing the forces of anarchy and revolt" (2017: xvii).

In support of this argument, Hippler draws attention to the particular Foucauldian 'boomerang effect' through which aerial bombing emerged as a weapon (*see* Foucault, 2003; Graham, 2010a). Whilst used in the First World War primarily as a form of support for other operations, it was in the interwar period that aviation established itself as an independent arm of the military (Hippler, 2017: 57-9). This independence was achieved not through bombing's deployment as a weapon of war, but rather as a form of colonial policing. The British first made use of what they would come to term 'police bombing' in 1920 against Mohammed Abdullah Hassan, the Somalian leader of an Islamic-nationalist insurrection in the Horn of Africa, and this was followed, throughout the 1920s and 30s, by broader attempts, by the colonial powers of the time, to govern their unruly subjects from the air (Hippler, 2017: 56, 70-2). In the subsequent military deployment of aerial bombing,

Hippler sees this policing aspect retained, its logic carried through but inverted. In other words, Hippler conceptualises the effects of bombing as an *anti-police*, a force for fomenting social divides; stirring up disorder; creating uncertainty. Paired with the targeting of vital infrastructure, this notion of an anti-police goes hand-in-hand with the intention to demodernise the enemy society and compromise the sense of ontological security, creating the conditions for forms of 'sedition' which could debilitate the war machine from within: dissenting opinion, protest, strikes and other modes of industrial action.

Stephen Graham furthermore outlines how 'infrastructural warfare' has become a key part of U.S. military doctrine in the latter years of the 20th century. Two models have been particularly influential here. First of all, in 1995, former US Air Force Colonel John Warden formalised the 'enemy-as-a-system' idea, developing his 'Five-Ring Model': the diagrammatic representation of the adversary society as a set of five concentric rings set one inside another, from the fielded military forces as the outer layer, to population, organic essentials, infrastructure, and leadership at the centre. Warden's model was then built upon in 1998 by the air power theorist Edward Felker, who presented his own version of the diagram with infrastructure as *an all-pervading bond holding together all other elements* (Fig. 4; Graham, 2007: 314-5). According to this model therefore, targeting proceeds with the intention of finding

"the 'tipping points' in critical infrastructure systems that will lead to the nonlinear, spiral effects that will most rapidly induce complete, societal chaos" (ibid: 315).

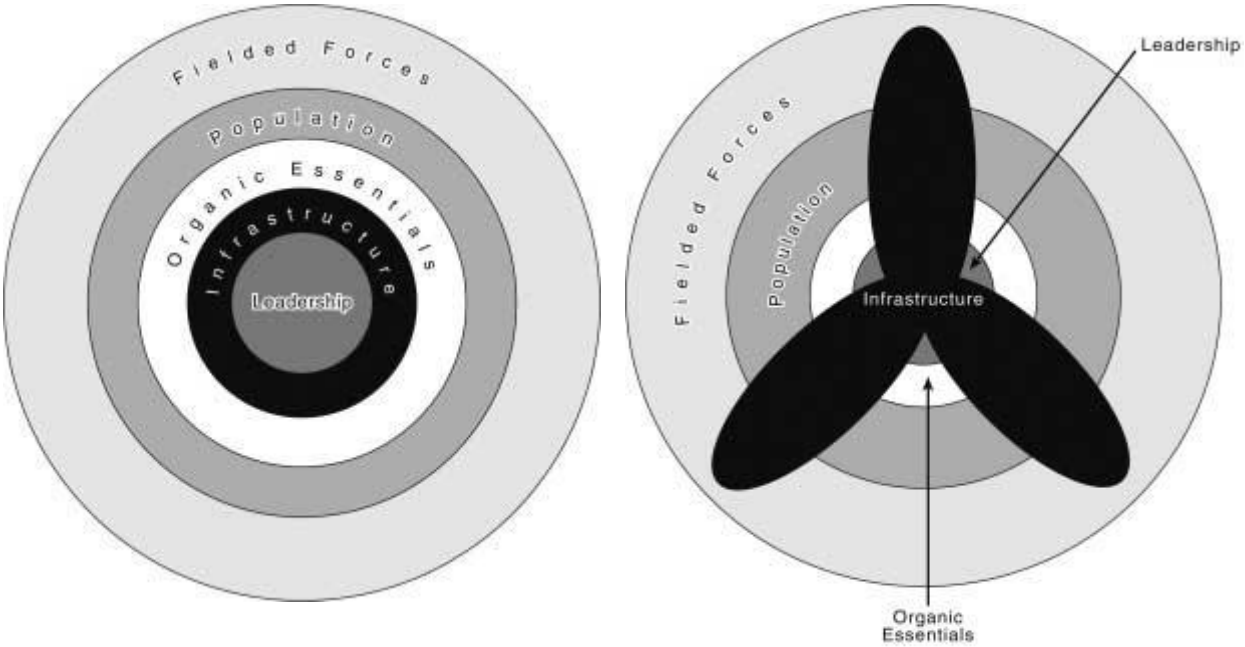


Figure 4: Left - Warden's 'Five Ring Model'; Right – Felker's version (source: Graham, 2007: 314-5)

The use of aerial targeting in the Second World War had served to demonstrate the radical – technical, but also socio-political – uncertainty which could be provoked through the destruction of one's own infrastructures. As such, post-war security in Western Europe and the US was orientated in two directions simultaneously: outward, towards the threat of Communism, and inward, toward the everyday dangers of industrialised society. Turning the promise of biopolitical governance back on itself, "[c]ivil defence authorities saw that, in the era of total war, the very systems that had been developed to support modern urban life were now sources of vulnerability" (Collier, 2008: 231).

The realisation of this catastrophic potential necessitated the production of new forms of knowledge in an attempt to render the threat amenable to thought and meaningful action. In this context the calculations of 'archival-statistical' risk associated with population security

would be insufficient for two main reasons. Firstly, whereas the production of statistics relied upon archival data: "a 'historical' record of past events – illnesses, crimes, incidents of poverty – in a population" (Collier, 2008: 227), the 'ideology of preparedness' (Sherry, 1977. *Cited in* Collier & Lakoff, 2015: 28) which dominated security strategies in the aftermath of the Second World War was concerned with the possible occurrence of events for which such a record could not be called upon (Collier, 2008: 231). This was the context in which modelling and enactment arose as prominent techniques in relation to the diagram of VSS (Collier, 2008). Carrying over the infrastructural anxieties of the previous conflict:

> "the assumptions behind strategic bombing were transposed into a paradigm for the protection of vital systems against nuclear attack. In the early years of the Cold War, planners developed techniques that made it possible to identify likely targets in the US, to model the effects of nuclear attack, and to anticipate requirements for emergency response" (Collier & Lakoff, 2008: 24).

In practice, this was achieved by collecting together a "catalogue of urban elements": significant features of a city (such as infrastructure) and detailed records of their physical make-up. These features were marked on a map of the city, onto which a series of concentric circles could then be overlaid to simulate the impacts of attacks of various magnitudes. The vulnerabilities of the city as a whole could therefore be estimated through the *juxtaposition, connection, and combination* of the individual vulnerabilities of urban elements (Collier, 2008: 231-232).

The techn(olog)ical aspects of this reflexive turn should not be understated. Undoubtedly, the realisation of a renewed vulnerability, and the knowledges which emerged to mitigate it, were associated, as Arendt had it, with "the weird *suicidal* development of modern weapons", and more broadly "the simple fact that 'technological progress' is leading in so many instances straight into disaster" (1969: 14; 16). At the same time however, we would

be remiss to ignore the socio-political undertones and implications. Linking the technical anxiety over complex systems with the socio-political anxieties out of which the governance of circulations first emerged, it is useful to ask where the population are in all this; what is their position or role? For instance, the investigative journalist Duncan Campbell has documented how, as the Cold War progressed – with warheads growing in both size and quantity on all sides – the outlook of UK contingencies planning increasingly framed the domestic population as a potential threat to the integrity of the state's vital functions in the event of a nuclear strike. "In Britain", Campbell claims in 1982, "the idea of civil defence has been turned on its head. The official policy, which is more correctly styled 'Home Defence', has, as its primary objective, the preservation of government – if need be, *against* the civil population" (2015 [1982]: xiv). In a separate article, Campbell (1982: n.p.) cites a Training Manual devised by the Home Office's Scientific Advisory Branch, in which volunteer scientists are advised that 'The Threat' of wartime can be divided into three aspects:

> a) "Internal threat (sabotage, subversion and possibly adverse public reaction to government policies)
>
> b) Conventional attack
>
> c) Nuclear attack"

Once more, the first consideration is for internal effects – the dangers posed by subversive groups, including "fomenting strikes in key industries, anti-war demonstrations to turn the populace against the government and disruptive activities connected with war preparations" (ibid.). Not only was the population not the ultimate priority then, but indeed the prospect of an absolute minimum of survival and recovery – the supreme expression, we might say, of resilience-thinking – pushed the population to a position of enmity in relation to the systems to be protected or saved. The threats of sedition and revolt associated with *raison d'État*

have evidently not been left behind altogether here, but rather re-orientated around the question of vital systems.

More specifically, it was *urban* populations that were identified as a potential source of post-attack disorder. Contingencies planning here intermingled with anti-urban scholarship, tying the catastrophic potential of a nuclear strike to socio-political anxieties and moral panics over the everyday life of the city (Farish, 2004). According to these analyses, the city represented the most likely target not only in a technical-strategic sense – because of the density of facilities for production and government, for example – but also because of the material, social and moral profligacies of urban life. The city was the most suitable reception centre for the new bombs "because, just like those bombs, [it was] the product of energy in destructive excess" (Conrad, 1994: 297. *Quoted in* Farish, 2004: 95). Especially in the U.S., the suburbs were advertised as an escape from these twin excesses: the catastrophic excess of the bomb, and the excesses of everyday urban life: immorality, crime, poverty, pollution, congestion, and so on. Planners such as Tracy Augur argued that by cleaning up urban areas, and forming new, well-ordered communities, planned dispersal could help to guard against "the type of penetration that has become so common and so effective in modern times and which depends on the fomenting of internal disorder and unrest" (Augur, 1949: 110). Correspondingly, it was feared that, in the event of an attack on the urban space, its disorderly tendencies would *spill out* into the surrounding areas; that, from the epicentre, "uncertainty and displacement would spread, upsetting conventions of domesticity, homeliness, and planned order that are the opposite of the city as ruin" (Farish, 2004: 96). Beyond the initial attack therefore, a number of knock-on effects were taken into consideration, based upon underlying feelings of both technical and socio-political-moral anxiety; the possibilities of 'cascading failure' expressed not only in the potential for

complex, tightly coupled systems to amplify the scale of effects, but, more broadly, in a perception of the city as an unhealthy site of density, excess, and circulatory intermingling.

Farish concludes by arguing that, as a consequence of this double anxiety, the logic of dispersal – repackaged as suburbanisation proper; the 'escape to the country' – had purchase well beyond the wartime context in which it was devised (2004: 106). Much the same can be said, more broadly, of the knowledge forms of aerial bombing and system-vulnerability thinking, which came to contribute to their own variety of (anti-)urban calculation. This was made manifest through the transfer of experts and expertise from military institutions to urban planning and governing bodies in the post-war era. As Light (2002) explains, the early 1960s especially was a period of uncertainty for defense research institutions. Reduced military spending prompted these organisations to hatch plans "to transfer their innovations beyond military markets" (ibid.: 608). New think tanks were established, applying military rationalities and technologies to solve urban problems. Notably, problems of the city (especially urban rioting) came increasingly to be conceived and treated as problems of security (ibid.: 609); what would latterly come to be known as 'securocratic wars' (Feldman, 2004; *see* Wekerle & Jackson, 2005).

Given the military context post-WWII, it should be no surprise that systems analysis, now increasingly utilising computer modelling techniques, was heavily involved in these new attempts at urban governance. A prominent example comes from the RAND (Research ANd Development) Corporation's influence on the New York fire department (FDNY) in the early 1970s. Originally an air force think tank (Light, 2002), RAND applied statistical modelling techniques initially developed for the war in Vietnam to response-time data, and from this determined the optimal distribution of fire stations across the city (Greenfield, 2017: 57). Evidently, the calculations failed to cope with the fullness of social complexity, and

as a consequence large sections of the city's poorest neighbourhoods burned to the ground (ibid.: 58).

The notion of systems analysis seems initially to belong to a strategic mode of thought. However, as shown above, it was specifically the *overlappings and interactions* between the multiple circulations of urban life which were deemed to constitute the possibility for the sudden and disproportionate multiplication of risk; the potential for the effects of events to 'cascade' across space, coming to loosen the very fabric of society. If urban infrastructures work as delivery systems for all kinds of 'goods', then their targeting and protection tended to concern not merely the potential for 'non-functioning' – an absence of circulation – but for their transformation into chains supplying and spreading destruction and uncertainty. As such, in discussing CIP and VSS it is important to take into account a mobility that exceeds strategy as traditionally conceived. As the proceeding chapter will argue, it is perhaps more apt to talk here of a *logistical* rationale as that which provides the basis for liberal urban governance, including its capacities of resilience. Moreover, if the prime concerns of war included the fomentation of internal divides, and disruption to chains of industrial supply and transportation by the population that used and operated them, then one can hardly hope to restrict the analysis of such phenomena to wartime itself. The disruption of infrastructure animates the problem of urban governance far beyond the spatial and temporal boundaries of that exceptional sphere of violence, wagering the survival of liberal, urban life as we presently know it upon the non-disruption of circulatory systems, of what Feldman (2004) referred to as 'the moral economy of safe circulation'.

This short historical introduction to infrastructural anxieties allows us, in the following section, to elucidate the broader contemporary politics of urban infrastructure, both in the sense of its role in constituting or maintaining a 'normal' state consisting of smooth

circulation, and in the associations between disruption and the politicising moment; the moment of revelation and critique.

1.5. The Political Stakes of Urban Infrastructure: Disruption and Revelation

> "The interruption of the moral economy of safe circulation is characterized as a dystopic 'risk event', a disruption of the imputed smooth functioning of the circulation apparatus in which nothing is meant to happen. 'Normalcy' is the non-event, which in effect means the proper distribution of functions, the occupation of proper differential positions, and social profiles"
>
> (Feldman, 2004: 333)

The meta-political problem of urban infrastructure, as it were, is that, given its general invisibility, together with its technical complexity, it is prone to become 'black-boxed' and depoliticised, left to the realm of technical expertise (Graham & Marvin, 1996; 2001; Graham, 2010a). As a result, infrastructure becomes a sphere of life in which inequalities of access and mobility can be disguised, fading into the accepted background as the 'normal run of things'; "the forgotten, the background, the frozen in place" (Star, 1999: 379). In Feldman's (2004) Rancièrian phrasing, the 'proper functioning' of circulation is a conceit for what is a certain 'distribution of functions'. As Rancière himself would have it, this is a matter of both conception and aesthetics; of what and who is made 'sensible', both as 'common sense' (that which 'makes sense') and, more literally, in terms of *aisthesis*, as that which is 'made available to the senses', able to be seen, heard, and so on (Rancière, 2010; Dikeç, 2012).

For Maria Kaika and Erik Swyngedouw (2000) too, the depoliticising tendency of infrastructure is both a symbolic and material process associated specifically with the shift from a spectacular 19th century urban landscape in which infrastructures tended to be put

on display, *held up* as beacons of the utopian modernity-to-come, to the 20th century in which they were increasingly buried beneath the surface; their failures and imperfections realised and repressed to a set of spaces in which they could be more surreptitiously managed (2000: 134). The visual spectacle of infrastructure as material process was in this way replaced with its symbolic presence as presumed circulation, together with singular moments of arrival experienced through the increasing ubiquity of 'outlets': taps, plugs, switches, and so on. As such, "[t]he supply of water, electricity, information etc. now appeared to be 'miraculously' entering the domestic sphere, coming from nowhere in particular and from everywhere" (ibid.: 134).

However, if the very order of liberal existence depends upon the smooth surface of the 'non-event', then the urban has always been troubling to this order as that which frequently gives rise to socio-political (as well as technical) disruptive forces. This ever-present possibility is where many critical analyses of infrastructure locate its political promise. It is argued that we only really take notice of these systems when they break down and/or burst out. This deeply influential idea originates from Susan Star's oft-quoted claim that infrastructure "[b]ecomes visible upon breakdown" (1999: 382). The various failures of infrastructure are thus put forward as revelatory moments in which we come to appreciate both the degree to which urban liberal society is dependent upon the interlinkages among these systems, and the inequalities expressed in and through efforts to cope with the fallout. Cresswell and Martin (2012: 523. *Quoted in* Kallianos, 2018: 770) summarise this point well, arguing that disruption to the regularity of outputs "can de-naturalise infrastructural systems and open them up to scrutiny – making the previously taken-for-granted mutable".

The simple notion of breakdown and revelation however does not capture fully the political possibilities of urban infrastructure. If we were to take this idea on its own, we might begin

to think of infrastructural failure as merely being a sudden shift from functioning to non-functioning; presence to absence; mobility to stasis. Whilst there may be elements of all these transitions as a result of failure, political interventions into and through infrastructure just as often take the form of *disruptions which give rise to their own kinds of mobilities*. Disruptions, in other words, are not static; they flow through the infrastructure that they disrupt. Moreover, their political effect is manifested in an amplificatory and often deeply sensory capacity. If order is circulatory and aesthetic, in other words, then so is its disturbance. We might look, for instance, at the nature of protest when the infrastructural status quo is objected to. In 2013, waste was not collected in the Greek city of Tripoli as a result of the regional government's decision – under pressure from the European Commission – to close illegal landfills in the area. Rather than staging a march or some other kind of popular protest, the city's residents opted to viscerally demonstrate the sensory effects of the political decision by repeatedly dumping their waste on the streets outside the government agency's offices, leading to the declaration of several states of emergency (Kallianos, 2018. *See also* McFarlane (2015: 7) on the so-called 'poo protests' in Cape Town's Barcelona settlement). This case highlights once more the fact that 'cascading failure' should not be conceived as a purely technical phenomenon. To do so is not only reductive; it also serves to construct a simple, normative binary of systems that do or do not work. What is omitted is the questioning of what 'working' means; what does the normality of a functioning infrastructure consist of, and when might disruption be warranted or necessary?

If infrastructures, in the terms of Michel de Certeau (1984), are strategic things, networks of linkages which attempt to enable the mapping and calculation of the city as a settled whole, then they may be unsettled through tactical acts – partial and small-scale agitations which work from the ground up. In this vein, Eyal Weizman (2015) comments on the significance

of traffic circles as sites for the mass protest movements which sparked the overthrow of regimes both in South Korea during the 1980s, and, more recently, across the Arab world. In *The Roundabout Revolutions*, he poses a theory for the recurrence of this method of occupation:

> "Occupying a roundabout demonstrates the power of tactical acupuncture: it blocks off all routes going in and out. Congestion moves outward like a wave, flowing down avenues and streets through large parts of the city. By pressuring a single pivotal point within a networked infrastructure, an entire city can be put under siege" (Weizman, 2015: 12)

Tactical acupuncture is a specifically infrastructural mode of politics, corresponding to the city's modern role as regulator of circulations. If space is no-longer governed as a container but instead as a matrix of circulations, then the tactical response consists in choking, (over)crowding, or 'flooding' critical points, provoking disruption to spread outwards from the epicentre. Disruption to urban infrastructure is in this sense a potentially political act because it enables the amplification of claims. By contra-functioning systems which, in their regular functioning, create the impression of continuity, the habitual 'normal run of things' likely to go unnoticed and unthought, it is possible to create spaces of appearance and contestation, and, more specifically, spur a reconsideration of the 'critical' systems of circulation themselves; the "congealed socio-economic and political interests" which they represent; the orders which they maintain and drive (Steele et al., 2017: 76; Bijker, 1995; Star, 1999; Graham, 2010a; 2010b; Dikec, 2017).

Despite the continued relevance of the above set of ideas, it will be the task of a later section to question further the binary of circulation/disruption – together with its correlate pairings of hidden/revealed; backgrounded/foregrounded, strategic/tactical, and so on – in light of the distinctly logistical governance of liberal urbanity. In building up to this point, the

following section places our above discussion of disruptions as mobile immobilities into the context of the Cabinet Office's Civil Contingencies Secretariat (CCS).

The origins of the CCS will be brought to light in order to demonstrate the extent to which this influential emergency body was informed in its approach by the problem of disruption and its potentially catastrophic political and social effects. The set of solutions proposed, as well as exemplifying a resilience outlook, also suggest the importance of both ways of knowing and doing intended to actualise in rapid response and to intervene *within* the emergency conceived as a mobile, spatio-temporal, and circulatory event.

Emergencies of Circulation, Emergencies of Disruption: The Politics of the Civil Contingencies Act

> "[Emergencies] are notoriously mobile, and difficult to predict, spreading like wildfire, cascading across different societal systems…Equally, emergencies constitute blocked mobilities. Some are trapped or stranded, or disorientated as to where to go, and are struggling to be set free"
>
> (Adey, 2016: 35)

The formation of the CCS, the government branch from which the CCA (2004) and its definition of 'emergency' would later emerge, may be read as a response to the problem posed by disruptions to complex and interdependent circulations. In developing this reading, there is first of all a case of false origins to be cleared up. The CCS was set-up by Tony Blair's Labour government in 2001. It is therefore tempting to see the CCS as the UK's answer to the U.S. Department of Homeland Security; a post-9/11 institution, reinforcing the link between the 'new terrorism' and resilience approaches. However, the CCS was formed in *July* 2001, two months *prior* to the attacks on Washington and New York (Zebrowski, 2009; Anderson & Adey, 2011). It was instead two other events, both domestic, which provided the impetus for the formation of the CCS: the fuel protests of September 2000, and the 'foot-and-mouth' epizootic of 2001 (*see The Telegraph*, 2001;

Coafee & Fussey, 2015). Though in many ways very different kinds of problem – one an issue of resources, the other of disease; one a benign circulation cut off, the other a malign circulation uncurbed; one of roads, the other of fields, and so on – these two events nonetheless came to be addressed in relation to one-another as a result of two shared features: firstly, the origins of both in the inadequate management of circulations and their intersections (including the unintended consequences of regulations themselves); and, secondly, the failure to contain or absorb the effects of the emergent event – spatially, materially, and symbolically – thus preventing large-scale political and economic damage. What is particularly evident in the conception of emergency put forward by the CCA, in other words, is the emphasis both on mobility – or, more precisely, the potential for hindered mobilities to produce still other (emergency) mobilities – and on socio-political (ie. not purely technical) concerns.

The fuel protests – in which, beginning on the 8th of September 2000, small groups of hauliers and farmers responded to high fuel prices by blockading roads and oil refineries, demanding change to the Government's rate of fuel tax – brought into sharp focus "not only the dependence of the UK economy on the road-transport system but also the relative ease with which it could be brought to a standstill" (Robinson, 2003: 425). Although small in number, the hauliers used their mobility within the system to enforce widespread immobility, blockading motorways and dual carriageways by conducting 'go-slow convoys' (Adey, 2010: 84). This led to a classic case of 'cascading failure', with "serious economic and social disruption" felt far beyond the immediate shortage of fuel. Within just a few days:

> "panic buying of petrol was widespread, with 90% of petrol stations running out of fuel by 13 September as the road-transport dependent supply chain broke down; commuting became progressively more difficult; rationing of fuel use to 'essential users' was introduced; supermarkets reported panic buying of staple groceries; the

> army was put on standby to ensure fuel deliveries to the emergency services, schools were closed and the NHS placed on 'red alert'" (Robinson, 2003: 424-5).

The motives behind the protest were "explicitly political, directly engaging the Labour government in a conflict which rapidly came to threaten its very legitimacy" (Robinson, 2003: 423). More than a matter of intent however, it was the very practice or tactic of disruption; of *imposing relative immobility onto multiple circulations via a cascading process*, which functioned as a tool for gaining political traction. As Adey says, through its disruption:

> "The road provided a visible public space and a forum for contestation and opposition to the way things were being handled. The acts of drivers impeded on others who were driving with them. Other drivers felt the effect of the queues some miles further up the motorway. And viewers of news broadcasts caught up with the events simultaneously or later in time" (2010: 84)

Once more, the term 'cascading failure' can be applied not only to the technical process by which the disruption spread and evolved through the complex interdependence of systems and supply chains, but also to the simultaneous social and political processes which amplified what was initially considered a minor, largely irrelevant claim into a pressing political question striking at the heart of government.

Whilst not triggered, like the fuel strikes, by an explicitly political act, the outbreak of foot-and-mouth – first discovered in a herd of cattle on an Essex farm on the 19th of February 2001, and leading, by November of the same year, to the culling of nearly 6.5 million animals (Law, 2004: 9) – came to pose similarly urgent and serious questions for government. To begin with, the disease was evidently heavily disruptive to the UK's rural economies, and again this occurred through successive volleys of interdependent effects. It was thus not just the direct loss of livestock that was costly. The measures imposed upon the mobility of farmers in the attempt to contain the disease's spread also incurred significant damages, and,

following the failure of these efforts, the country temporarily lost its disease-free status with the Organization International des Épizooties (OIE) – the body which informs the EU and WTO on trade relating to animals and micro-organisms – forfeiting, for a period of almost a year, its right to export animal products (Law, 2004: 4; 6; 9). The total cost of these (im)mobilities – mobilities unconstrained and immobilities enforced – was estimated, by Iain Anderson's independent inquiry into the outbreak (commissioned by the Prime Minister and the Secretary of State for Environment, Food and Rural Affairs) to be in the region of £8bn (Anderson, 2002: Appendix A).

Moreover, Law's (2004) analysis argues that the disease itself was constituted by far more than the biological nature of the virus but additionally by the composite of circulations (including those of sheep and pigs, as well as food and waste) which facilitated its rapid geographical spread. Contributing factors included the UK's economic geography of livestock mobility, its cultural geography of meat consumption, as well as the very regimes of health and safety intended to prevent the outbreak of diseases in the first place (2004: 9). With regards to this latter set of factors, Law mobilises the engineering notion of the 'levée effect' – the process whereby the sociotechnical engineering of river systems to prevent floods unintentionally exacerbates the impact of flood events – to translate Beck's 'risk society' thesis into the mobilities paradigm (Sheller & Urry, 2006; Adey, 2006). He points out how it was, for instance, the increasingly stringent health and safety standards governing UK abattoirs which exacerbated the rate of foot and mouth's proliferation: the extra cost of adhering to the legislation led to the closure of a large proportion of the country's abattoirs over the preceding three decades, leaving behind a relatively small number to which livestock would have to be transferred for slaughter (2004: 8-9). The result was, to put it in general terms, *an intensified set of circulations and densities*, enabling the rapid and unpredictable transfer of the virus via multiple points of intersection. Such unintended

consequences thus simultaneously produce both immobilities and mobilities; disruptions which themselves circulate or flow. As Law says:

> "we are dealing not with one flow, the flow of a virus, but a pattern, a web, of partially connected and different flows with criss-crossing barriers, and it is the intersection of these different flows and their levées that produces the potential for leaks. Trade, economic, personal movements, policy regimes, even safety and hygiene systems, *all* of these are regimes of flow, all foster mobilities, all imply barriers, and all of them, their intersections and the intersections between their barriers, play their part" (2004: 10)

In the inquiry, Anderson suggests a change in approach for coping with emergencies of this kind. Notably, he quite clearly foreshadows the resilience outlook of the CCA, proposing that "[l]ooking ahead, the processes of horizon scanning, contingency planning, rehearsal and learning from mistakes should become part of government routine" (2002: 10). As such, it was not the initial outbreak of 'foot and mouth', nor the discontent of hauliers, which the UK Government sought to address as remedial action to these two events, but rather the creation or improvement of mechanisms which could detect and rapidly respond to their effects, minimising disruption, and, ultimately, preventing the evolution of infrastructural emergency into political disaster.

Notably, by emphasising the circulatory nature of these two events, the CCA and CCS are not exclusively focused on preparing for and recovering from; they also intend to make provision for *intervention within*. By 'acting out' the interactions between multiple agencies, improving the speed and smoothness of their coordinated actions, the Act institutionalises a highly flexible form of emergency governance suited to responding rapidly to a wide range of possible scenarios. Adey and Anderson thus identify the aim of the CCA as that of "produc[ing] a system of response and recovery that itself exists in potential: primed to actualise in relation to an event" (2012: 29). In practice, they argue, this means establishing

"a potential network of designated organisations that can be actualised during an emergency…[t]his network has no permanent existence as the organisations remain formally separate until an event happens and is recognised…" (2012: 30). Such an approach corresponds with Anderson's analysis of rapid response, wherein pre-emptive and anticipatory technologies are paired with institutional 'readiness': "Often occurring alongside various early-warning systems that can scan the present for traces of emergencies as they unfold, rapid response involved setting up a potential network of organisations that exist in a constant state of readiness for events to happen" (n.p.). Again, this is not without its precursors. Alongside the 20th century feelings of uncertainty for instance, there emerged certain institutional forms; that is, potential institutions for potential emergencies. Collier and Lakoff make reference here to President Roosevelt's 1939 Reorganization Plan which made provision for an Office of Emergency Management, an "office-in-embryo" to be "constituted in the event of an emergency" (Rossiter, 1949: 1209; Collier & Lakoff, 2015: 36). What is unique about the contemporary approach is that we are talking not just about an 'office-in-embryo' but about *networks-in-embryo*: a large range of multi-agency relations, mechanisms, and protocols that are triggered, in different combinations, by the emergent event, and mobilised to intercept, manage, and ultimately mitigate its spread.

As Anderson mentions, the promise of rapid response is linked to the availability of early-warning systems and other technologies of communication, monitoring and tracking, which aim to keep pace with events as they unfold, opening up new zones of calculation, perception, and meaningful action. As the next section will explain, such technologies have often been tied to a broad phenomenon which, developing separately from but also in relation to that of the 'resilience turn', marks out the current project as one of 'smart urbanism'. Building upon the general claim that, especially in the post-industrial world, cities and their systems have become dependent to an unprecedented degree upon Internet and

Communications Technologies (ICTs), 'smart urbanism' seeks to harness the calculative potential of the data produced by this interactivity. I will argue that this framework arises in tension with that of resilience, appearing to question the retreat from aspirations to control (know, secure, etc.) with which the latter is associated. This line of criticism is directed especially from those who view smart urbanism as a project heavily linked to the 'corporatisation of city governance' (Kitchin, 2014); that is, to the growing influence of profit-hungry multinationals such as IBM and Google on how cities, their systems, and their populations are monitored, and how urban space is negotiated, navigated, produced, and consumed.

My own argument shares a number of points with this literature. However, I will furthermore come to argue that, like resilience, smart urbanism offers a useful but insufficient perspective from which to critically address current trends. To put it very briefly, the notion of the smart city turns out to be too vague, too utopian, too whole, and too abstract to capture the intricacies of liberal urban governance.

1.6. Smart Urbanism: (Re)asserting Control?

> "By capturing a phenomena as real-time data it seemingly becomes possible to model, understand, manage and fix a situation as it unfolds"
>
> (Kitchin, 2014: 9)
>
> "Early in the next millennium your left and right cuff links or earrings may communicate with each other by low-orbiting satellites and have more power than your PC"
>
> (Negroponte. *Quoted in* Massumi, 1995: n.p.)

In this chapter it has been suggested that resilience is not a form of surrender but rather proposes new forms of knowledge with which to render unpredictable, rapid-onset events

amenable to thought and meaningful action. Specifically, it has been argued that such ways of knowing are oriented towards urban circulations and disruptions, and, more accurately, to rapidly responding so as to intercept disruption before it spreads, and to intervene within the event as it develops. For this to be possible requires that one has a deep understanding of urban infrastructural elements and their interdependencies, forming the capacity to model, simulate, or enact possible emergencies. This is the essence of what Collier and Lakoff (2015) describe as 'system-vulnerability thinking', the form of knowledge underpinning the diagram of VSS. However, this model does not take fully into account some of the important aspects of 'rapid response' outlined above.

Although modelling and enactment are crucial to emergency governance in developing a generic capacity for response and honing the reflexes of agencies – their ability to be familiar with one-another's capacities, priorities and behaviours – an exclusive focus on forms of rehearsal detracts from how these virtual or potential networks are actualised within the event itself. To this effect it is worth re-posing a question from the beginning of this chapter: How do security agencies insert themselves into the within of the emergency? If the effectivity of 'rapid response' depends upon the triggering of virtual networks (networks-in-embryo) to intervene in the event as it unfolds; to neutralise disruption by re-routing circulations around it, then how does this actualisation take place, in a flexible, collective and instantaneous way? What form(s) of knowledge and what apparatuses permit the identification of an emergent disruptive event, the coordination of response, and, simultaneously, the circumvention of 'normal' urban circulations?

One pre-eminent answer is to be found in the idea of 'smart urbanism'. The smart city, as an attempt to bring control (back) to the governance of the urban, is premised upon the mass calculation of the city, on an unprecedented scale and in 'real-time'. Through this continuous

calculation, the city's innumerable elements and interactions – or rather, the data extracted from them – are broken down and re-assembled in new combinations in order to generate previously undiscovered relations and insights. In the following sections the logic and consequences of this project will be examined, with a particular focus upon the accusations that it ultimately provides a vehicle for the corporatisation of urban governance.

Smart City, Real-Time City: A Whole in Need of Connection

The ubiquity of the 'smart city' label reflects a growing influence exercised by information and communication technologies (ICTs) on the governance of the urban (Kitchin, 2014). Liberal urban spaces are increasingly characterised by 'continuous connectivity' (Wilson, 2014) and the mutual dependence between material spaces and various types of software and code (Dodge & Kitchin, 2004; Kitchin & Dodge, 2011). As well as being a major contributor to its technical complexities and vulnerabilities however, 'smart city' projects and discourses posit this 'everyware' as a long-awaited solution to the troublesome uncertainty of the urban (Greenfield, 2006. *Cited in* Kitchin, 2014). Following in the footsteps of the computational models and simulations involved in systems-thinking, the promise of the smart city is based upon the possibilities of analysing so-called 'big data'. This unprecedented "data deluge" is extracted from the multiple networked technologies and sensors embedded within the urban environment and carried by and on its inhabitants, in the hope of "provid[ing] much more sophisticated, wider-scale, finer grained, real-time understanding and control of urbanity" (Kitchin, 2014: 3; Gabrys, 2014; Greenfield, 2017). In particular, smart city technologies are attendant to the monitoring of urban infrastructures "in the hope that emergent anomalies in their behaviour or performance can be detected early, and dealt with while they're still of manageable scale" (Greenfield, 2017: 50).

If one was to choose a single word with which to characterise the smart city project, it might well be 'integration'. For it is only through the collective analysis of the city's 'data fumes' that real-time calculations of the urban space as a whole are conceivable (Thatcher, 2014). To this end, Kitchin (2014: 5) notes that, whereas urban monitoring tools have traditionally been "isolated systems dealing with a single issue and…controlled by a single agency", "[m]ore recently there has been an attempt to draw all of these kinds of surveillance and analytics into a single hub, supplemented by broader public and open data analytics". Integration is accomplished through the merging of previously separate databases and monitoring facilities – control centres and 'urban dashboards' (Mattern, 2015) – as well as via the implementation of Urban Operating Systems (Urban OS): software platforms, often produced by large technology corporations, that establish connections between formerly unconnected systems and datasets (Marvin & Luque-Ayala, 2017: 93). Notably, in order to justify the entry of such technologies into city governance, "a collapse between corporate and urban problematics is required" (ibid.: 92). For instance, IBM's (2012) *Intelligent Operations for Smarter Cities Administration Guide* "identifies fragmentation and dispersal of control, lack of real-time updates, system isolation and inability to generate insights from existing data as the key problems of the city", the suggestion being that "[i]f the problem of a city, just like that of business, is one of fragmentation of functions and disconnected information, then the city should be amenable to software/hardware packages that can develop interoperability, interconnection and integration" (Marvin & Luque-Ayala, 2017: 92)

Urban OS therefore constructs the city not only as a whole but, somewhat paradoxically, as *a whole in need of connection* (ibid: 94-5); a system of systems which are interdependent in how they function, but not necessarily in how they are negotiated, communicated, managed, and above all *calculated*. This declared lack – lack of integration, lack of calculation – turns

the disruptive excess inherent to the city and infrastructure into a set of possibilities; connections to be made. At the same time, it reconstitutes the potential for seamlessness, a mode of security-as-continuity which can be maintained in spite of its being at odds with a reality of frequent disruptions. In contradistinction to the notion of the end of security with which this chapter began therefore, smart city narratives revive securability through the prism of resilience in real-time. Motivated by the belief that meaning, reason, and value lie in the as-yet unconnected or underconnected (but nonetheless pre-existing) relations between disparate pieces of information (Leszczynski, 2015), one needs only to 'discover' this deeper meaning by organising, integrating and centralising the sum of data produced by the actions of a system so as to be able to adequately 'exploit' the relations between it (*see* Horvath, 2012: 16; Thatcher, 2014). Greenfield here identifies a clear philosophical position to the smart city discourse which, we might observe, is directly opposed to Chandler's earlier characterisation of the resilience outlook: "We might think of it as an unreconstructed logical positivism, which among other things holds that the world is in principle perfectly knowable" (2017: 52). More specifically, it proposes that the city is something we might (finally!) be able to understand, predict, and control in all its complexity, if only we had enough data (Kitchin, 2014).

The claim that these processes are influenced by corporate interests identifies at the heart of the project of smart urbanism the aim to know and to secure circulations as a means to profit from them. Thus, rendering circulations 'amenable to thought' allows not only for the impression of security; it is simultaneously a crucial precondition for the production or extraction of value (Osborne & Rose, 2004: 212; Crampton & Elden, 2006: 681-2. *Quoted in* Luque-Ayala & Maia, 2019) – doing so allows one, in the terms of Gavin Bridge (following Stuart Elden), to evaluate what a space *contains*, both now and at a certain point in the future, to establish who owns the resultant revenues, and at the same time to allow for

insurance against possible losses (Bridge, 2013: 56; Elden, 2013; *see also* Crampton, 2010). Though Bridge refers primarily to flows of materials such as oil, one of the notable developments enabled by 'smart' technologies has been the application of similar ideas of prospecting, mining, and extraction to social mobilities and interactions (Mezzadra & Neilson, 2017). This is particularly evident in the literature on spatial big data, software-sorted geographies, and Location-Based Services (LBS), which emphasises the extent to which the continuous updating of the position on the earth's surface of any owner of a smartphone (or other GPS-equipped device) serves to influence not only how we interact with our environment, but also how that environment is produced and consumed (Graham, 2005; Thatcher, 2014; Leszczynski, 2015).

Despite its name, 'big data' is not just about size. Rather, it concerns both the *volume* of data, together with its *velocity* and *variety* (Horvath, 2012: 15. *Cited in* Thatcher, 2014: 1767). In other words, it refers to the speed of access and calculation across a range of sources. Thatcher (2014: 1768) here notably makes reference to Hey, Tansley and Toelle's (2009) claim that such methods constitute a 'fourth paradigm' of scientific praxis, beyond empiricism, analysis, and simulation. This paradigm is based upon ideas of 'discovery' and 'exploitation' and, as such, it differs from aforementioned forms of knowledge based upon enacting future possibilities by instead attempting to detect and intervene within interrelations and interactions as they occur. For citizens of cities increasingly subject to 'smart' technologies and projects, this means that to an increasing degree everyday life is part of an array of automated and near-instantaneous feedback loops: one's action or movement produces capta which is fed in real-time into a database. Along with countless other data fumes, this is acted upon by algorithmic forms of calculation, and then fed back as a visual or other representation to the very user who is helping to create it (Thatcher, 2014). Consequently, these types of real-time relation are argued to transform urban

citizenship into what Jennifer Gabrys (2014) terms 'citizen sensing', an enrolment which risks delimiting urban subjectivity to one's ability to participate in, manage and respond to the city as data to be manipulated and, ultimately, optimised.

In chapter two these problematisations of urban subjectivity will be revisited and examined in further detail. First though it is necessary to problematise the framework of 'smart urbanism'. For all its advantages, this framework has significant pitfalls which make it unfit for comprehensively grasping the intricacies of urban governance in cities full of friction and disruption.

Smart City, Tragic City

> "With their inherent diversity and complexity, we can usefully think of cities as *tragic*"
>
> (Greenfield, 2017: 55)

There are a number of issues with 'smart' as an analytical framework. First of all, 'smart' is a value-term, and as such can appear self-congratulatory, as if a normative assessment of the beneficial nature of anything under that label is always-already contained within it (Hollands, 2008). Secondly, 'smart' suggests both novelty and completion. It gives little indication of history, nor of failures or resistances other than what it (implicitly or explicitly) labels 'dumb'. Finally, 'smart' encapsulates a large number of, sometimes conflicting, perspectives and definitions. From one perspective, 'smart' means citizen-led, open, and radical; from another, it indicates a corporate, neoliberal ideology, and/or – as we shall expand upon shortly – a continuous form of surveillance typical of the Deleuzian 'control society' (Deleuze, 1992; Söderström et al., 2014; Greenfield, 2017. *For a critique see* McFarlane & Söderström, 2017). Finally, it is possible that the idea of 'smart', given its associations with ICTs, focuses on the corporate and the digital at the expense of more nuanced analyses of power and influence across private and public spheres. This in turn leads to a crucial point,

that 'smart' in its important critique of corporate-led fantasies, nonetheless goes too far in its move beyond notions of friction, uncertainty, and resilience. As Leszczynski (2015: 967-8) points out for example, spatial big data, even when produced and captured through the services of corporate entities, can still be viewed in relation to the state and its surveillance apparatus. Risk and security thus remain relevant, intertwined with the much glossier and more positively-charged rhetoric of 'smart'. More broadly, as Greenfield (2017: 55) observes, the smart city's search for control appears unrealistic and ultimately doomed to failure in the face of the 'tragic' character of the urban.

It is with this set of criticisms in mind – particularly the need to take within our analysis the 'smart urbanism' literature's emphasis on corporate influence, whilst at the same time balancing this with a continued consideration of resilience as the management of circulation's uncertainties – that we can now turn to a third literature: that of logistics. As opposed to the relatively static outlook of strategy, logistics has always been concerned with the relations between circulation and friction. Resilience, from this perspective, becomes a matter not only of preparedness, but also of response; of intervening in the midst of circulations. Whilst military in origin, we will see that logistics has both influenced and been influenced by its work in the corporate sphere during the latter half of the 20th century. This dual heritage gives rise, I claim, to a form of power that is simultaneously 'negative' (risk-averse; resilient) and 'positive' (profit-seeking; opportunistic). In order to clarify this idea in relation to urban governance, I will refer in particular to Deborah Cowen's (2014) notion of 'city logistics', a technique of calculative and spatial retrofitting intended to optimise urban circulations and manage their inevitable frictions.

2. Between and Beyond the Resilient and the Smart: Introducing Logistical Power

2.1. Introduction

The intention of the preceding literature review chapter was to identify and demonstrate the tense cohabitation of resilience-thinking and smart urbanism in relation to the circulations, risks, disruptions, and commercial imperatives of urban order and governance. To account for this tense cohabitation, the current chapter will turn to logistics. Drawing on a significant body of recent work, it will argue that logistics is a uniquely oscillatory form of power that attempts to resolve – or, perhaps more accurately, to maintain an impression of resolution between – the tensions of circulation and disruption.

Logistics originates as a military art, and begins to influence the thinking of liberal governance as early as the 18th century. It is also part of the broader post-WWII transfer and diversification of military thought into the spheres of civil defence, emergency preparedness, and urban governance discussed in chapter one. In particular, this military logistics emphasises the need to calculate, account for, and manage the friction that is inevitably produced by systems of circulation and distribution. However, I argue that what studies such as that of Collier and Lakoff do not account for is another post-war transfer of military expertise, this time into the corporate sector, in what scholars of logistics have variously termed the 'logistics revolution' or 'revolution in logistics' (Bonacich & Wilson, 2008; Cowen, 2010; 2014; Chua et al., 2018; Danyluk, 2018). This transfer sought to bring the benefits of systems-thinking to the operation of the firm by envisaging and calculating the corporation as an integrated system of circulations in need of optimisation through increases in speed, reliability, capacity, and flexibility. Logistics in this sense attempts to ensure 'business continuity' in the face of a range of disruptive events impacting supply-chains and other circulatory systems – from terrorist attacks and natural hazards, to

protests and strikes – by building redundancy, and ensuring the capacity to divert or re-route circulations around sites of disturbance. At the same time, however, logistics is transformed from a military art concerned exclusively with managing and minimising frictions, into a more profit-orientated, 'positive' way of thinking and doing. In the increasing deployment of 'real-time', 'big data', and IoT technologies in the monitoring and management of urban infrastructures therefore, what we are seeing is not merely the extension of 'resilience-thinking', nor the birth and spread of the 'smart city'; rather, what we are witnessing is a return of military logistics to the city via the logics and aims of the corporate. According to what we, borrowing from Cowen (2014), can call 'city logistics', the frictions and turbulences of the urban are framed not only as threats to the security of liberal circulatory life, but also as opportunities for the discovery of untapped value.

The chapter then returns to the political stakes of infrastructure, and its associated subjectivities, finding that the notion of logistical power raises difficult questions for how we currently conceive of the dynamics between circulation and disruption; the strategic and the tactical. Moreover, by emphasising the idea that the political order maintained through infrastructure is both mobile and aesthetic, logistics brings to the fore the embodied experience of circulation as well as its abstract representations.

Finally, the chapter revisits Collier and Lakoff's schema in order to suggest augmentation based on the patterns of governance described above. The fundamental theoretical argument here is that contemporary efforts to manage and respond to the uncertainty of circulations significantly alter the mechanisms of VSS by facilitating means with which to attain systems-thinking on an *instantaneous* and *continuous* basis, allowing for the constant reordering of circulations to circumvent unexpected disruptions as they unfold, as well as to

extract added value. The concluding section therefore posits a tentative supplement in the form of what I call 'logistical power'.

2.2. From Strategy to Logistics: the Calculation of Friction

> "[L]ogistics is not reducible to a mundane science of cargo movement or a discrete industry among others. Rather…it is better understood as a calculative rationality and a suite of spatial practices aimed at facilitating circulation"
>
> (Chua et al., 2018: 618)

If we look to the roots of 'infrastructure', we see that it has always been military, first applied to "physical installations that formed the basis or target for any military operations" (Der Derian & Finkelstein, 2008: 86). In the previous chapter, this association was elucidated in terms of the strategic aims of targeting, in which the enemy was envisaged – as in Felker's model – as an interconnected whole. However, by focusing exclusively on strategy, we tend to pass over the very processes of interconnection themselves. These processes are the concern of logistics. The origins of logistics lie alongside strategy and tactics in the 18th and19th century theorisation of war – particularly the work of Antoine-Henri de Jomini and Carl von Clausewitz – wherein it was the lesser-known of the three military arts (Cowen, 2014; Bousquet, 2018). Whilst strategy referred to the abstract, totalising procedure of "making war upon the map", and tactics to the deployment of material forces on the field of battle, logistics was the calculative art and science of coordinating supplies – munitions, food, and personnel – to the front line (Neilson, 2012: 325). Although initially marginalised in military thought, logistics acquired greater importance as armies grew ever-more dependent upon the chains of supply that fed them; that, is, as war became a 'just-in-time' pursuit (ibid.: 322). Etymologically, the word 'logistics' is traced back to the Greek *logistikos*, which translates as 'skilled in calculating' (Cowen, 2014: 26; Chua et al., 2018: 621). More specifically, it is calculation applied to the whole operation of war. For Clausewitz,

therefore, it was the ability to take into account, all at once, the sum of every infinitesimal movement, disruption and delay, in order, ultimately, to minimise the overall 'friction' of warfare (2007 [1873]: 50. *Quoted in* Cowen, 2014: 28). Cowen (ibid.: 29) notes the context for Clausewitz's work, the Napoleonic Wars, as an important era in the development of logistical thought – leading, for instance, to the innovation of food canning techniques – but marks the 20th century advent of industrialised, POL (Petrol, Oil, Lubricant) warfare as the point at which logistics began to take centre stage (*see* Neilson, 2012). It was thus with the aforementioned mechanisation of warfare that logistics attained its position of prominence. Via this process, the logistics of supply went from being a one-off exercise preceding the war effort, to a continuous circulatory regime pervading and underlying every one of its movements across both map and field. War, from this perspective, is not an activity which *takes place* within a certain demarcated space and time. Rather, it involves the continual arrival of various elements which produce the possibility for military engagement. Victory, as such, is less a matter of the size of one's army, the cunning of one's strategy, or the execution of one's tactics, and more fundamentally a question of timing, and of the velocity and reliability of one's infrastructural supply-chains.

According to Julian Reid (2006), the influence of logistics upon liberal societies as early as the 18th century explains "the ultimately paradoxical character of liberal modernity" (2006: 3): its declared ideal of 'perpetual peace', on the one hand, and its increase in military capacities for the targeting and violent destruction of human life, on the other. He argues that this paradox is rooted in the fact that the form of life liberal regimes are attempting both to promote and to defend globally – as a life worthy of life – is itself derived from military practices. In his words: "The liberal way of life, which the leaders of liberal regimes as well as the proponents of liberal international theory, proclaim as the progenitor of peace, has its ultimate origins in the preparations of societies for the act of war" (2006: 12).

Liberal life is founded then upon a kind of military readiness, a capacity to move things and people into the right place at the right time. Liberal modernity is, for him, "a process underwritten by strategies of *pacification* pursued through a range of disciplinary and biopolitical techniques deriving from the military sciences" (2006: 18), the aim being "to render life receptive to logistical formatting" (2006: 27) and ultimately to produce what he calls 'logistical life':

> "a life lived under the duress of the command to be efficient, to communicate one's purposes transparently in relation to others, to be positioned where one is required, to use time economically, to be able to move when and where one is told to, and to be able to extol these capacities as the values for which one would willingly, if called upon, kill and die for" (2006: 20)

For Reid, logistical life is a mode of subjectivity achieved through both disciplinary and biopolitical forms of power. The obligations of efficiency, communication, and position are thus read as, on the one hand, a tactical notion of bodily movements – the meticulous marching drills of the soldier, for example – and, on the other, a strategic sense of the circulation of populations; the movements of bodies relative to one-another. Strategies are thus what "combine, integrate, and coordinate", standing for "the processes by which the life of individuated bodies is rendered into the logistical life of populations" (2006: 32-3). As such, Reid argues that liberal strategies are always strategies of movement and position, always 'logistical strategies':

> "This is precisely why we must collapse the traditional distinctions between logistics and strategy and speak instead of the 'logistical strategies' of liberal regimes" (2006: 33)

Paul Virilio relatedly takes logistics as being central to governing the modern liberal city in particular. Within the emerging state as a space of circulation, cities took up the challenge of governing flow. Introducing the 2006 edition of Virilio's *Speed and Politics*, Benjamin Bratton

argues that "[c]ities govern…multiple scales of relative object velocity. They accelerate and/or frustrate" (2006: 10). For Virilio, in fact, the urban is nothing other than a 'stopover'; a space of 'habitable circulation' founded upon the governance of speed (Virilio, 2006 [1977]: 31; 37; Bratton, 2006: 9). This focus was concretized in the construction of large-scale infrastructure projects, the disciplining of various circulations into routeways through which they could flow perpetually and *en masse* (Adams, 2018: n.p.). Much as canning techniques did for the military supply of food, and intermodal freight containers would later do for the global shipping of commodities, the standardisation and containerisation of flow facilitated by civilian infrastructures rendered circulations as scheduled and calculable (*see* Cowen, 2014: 29). Consequently, the question of order is considered not primarily in terms of whether the 'system' is functioning or not, but rather in terms of regulating speeds, and minimising the *inevitable* frictions of circulation. For Virilio, this function is even more important politically than the Marxist category of class:

> "The State's political power…is only secondarily "power organized by one class to oppress another." More materially, *it is the polis, the police, in other words highway surveillance*, insofar as, since the dawn of the bourgeois revolution, the political discourse has been no more than a series of more or less conscious repetitions of the old communal poliorcetics, confusing social order with the control of traffic (of people, of goods), and revolution, revolt, with traffic jams, illegal parking, multiple crashes, collisions" (2006 [1977]: 39)

Logistical capacity is therefore engendered as the main 'quality of life' in liberal societies as a means to ensure that members of the population are aware of their need to exercise, hone, and, if called upon, defend that capacity (Reid, 2006: 35). Such a perspective additionally renders the aforementioned idea of 'imaginary self-sovereignizing' (Lorey, 2015: 26) into a specifically circulatory mode of conduct; a responsibility to measure one's conduct vis-à-vis one's circulation and the circulations one might enable or hinder.

Whilst our discussion of logistics thus far has described it predominantly as a militarily-derived form of knowledge aimed at the calculation of circulations and their inevitable frictions, I now hope to advance the discussion by referring to the more 'positive' and profit-oriented aspects of logistics. This section draws upon a large body of recent work that focuses on the post-war 'logistics revolution', bringing attention to the growing role of logistics in contemporary iterations of capitalism. My contention is that this role must be considered not as an alternative to but rather *alongside* logistics' military, risk-orientated origins.

2.3. The Revolution in Logistics: Negativity and Positivity

The entry of military expertise into urban planning and management during the latter half of the 20th century is mirrored by a corresponding transfer into the corporate sphere, wherein those same forms of knowledge which in public life were being used to assess, model and calculate the complex interactions of the city, were in the private sector being deployed to streamline business operations in the search for ever-greater profit margins. This transformation has been variously dubbed the 'logistics revolution' (Bonacich & Wilson, 2008; Danyluk, 2018) and the 'revolution in logistics' (Neilson, 2012; Cowen, 2014). Characterised by the import of systems thinking and analysis into the operation of the firm from the 1950s onwards, the revolution was a revolution in calculation; a revolution in how circulations were calculated, both economically and spatially (Cowen, 2014: 23). Crucially, it brought the calculation and optimisation of efficient, synchronous circulations to the very heart of contemporary urban capitalism.

It has been noted already how logistics originated in a military context as the collective calculation of unavoidable frictions, and how, according to Julian Reid's (2006) Foucauldian reading, logistical techniques were central to the entry of military forms of discipline and

biopower into the civic sphere. However, as our framing of the modern liberal city and its infrastructures has indicated, economic and capitalist interests have often been infused with such techniques of government (*see* Dillon & Reid, 2009: 134). This relationship has become increasingly close as capitalism and its modes of production have shifted towards more flexible incarnations, putting an emphasis on distribution networks, supply-chains, 'just-in-time' methods and mobile, circulatory forms of value (Deleuze, 1992; Thrift, 2005; Reid, 2006). Whilst the emergence of late-capitalism has often been linked to the kinds of technological developments illustrated in the 'smart cities' literature, the logistics revolution offers an alternative (or perhaps supplementary) origin story which emphasises the role of scarcity, friction, and violence.

Although the aims differed, the post-war revolution retained the Clausewtizian rationale of military logistics. One of the crucial calculative technologies behind this shift was again a brainchild of the RAND Corporation: the concept of 'Total Cost Analysis' which had been developed in post-WWII research on Air Force weapons systems (Fisher, 1956; Cowen, 2014: 40). Using computational techniques of analysis, this enabled a systems perspective on the firm; "a radically new management perspective in which a range of activities that had previously been handled in isolation – purchasing, manufacturing, transportation, warehousing, returns – were brought together into the same calculative frame…with the objective of maximizing profits across the supply chain as a whole" (Chua et al., 2018: 619; *see also* Cowen, 2014: 35). Logistics thus underwent "the move from a cost minimization to a profit maximization approach" (Neilson, 2012: 323). Specifically, this was realised through far greater importance attributed to practices of physical distribution, a previously peripheral and isolated function which thereafter was integrated within the process of production (Cowen, 2010; 2014; Danyluk 2018). The key to the firm's success, according to this new mode of thought, lay in the cumulative value-added which could be generated by

organising and analysing the supply chain as a complex and interrelated whole. Again, this was not just a matter of computation but also of circulation, a question of how one could optimise the system of circulations comprising an organisation's disparate functions.

In addition to the push factors which spurred the diversification of military expertise into civilian pursuits, the revolution in logistics has also been linked to crises in big business which produced the need for new ways of generating profit. In particular, the 1950s, 60s and 70s brought squeezes on profits in the U.S. and Western Europe as a result of a combination of factors – from recessions to oil price shocks – prompting business leaders to seek out the relatively underexplored frontier of distribution as a potential source of cost savings and value-added (Cowen, 2014; Danyluk, 2018: 633-4; Chua et al., 2018: 619). Beyond these historical factors however, it has furthermore been claimed that logistics' connection to capitalism is more than just circumstantial. Danyluk (2018: 635-7), for instance, relates the 'logistical fix' to five of capital's inherent desires, all bearing on circulation: "the annihilation of space by time" (Marx, 1973: 524. *Quoted in* Danyluk, 2018: 635) – that is, increases in *speed*; reductions in *costs*; perpetual *capacity growth*; *reliability*; and *flexibility or agility*. With respect to the first, Danyluk contends that the revolution in logistics marks the prioritisation of circulation's speed over all other structuring factors:

> "While profit-seeking enterprises have always sought to speed up the movement of their commodities, the logistics revolution signals a crucial inflection point in this long-run trend, a moment at which the pursuit of shorter turnover times on the part of individual firms cumulates in the reorganization of the circulatory system as a whole" (Danyluk, 2018: 635)

In relation to the second, he argues that, given the centrality of circulation, cost reductions are sought through the exploitation of labour in transportation and distribution industries, and the art of inventory control; that is, the application of just-in-time methods to bring

demand and supply into temporal and spatial proximity, thus maximising circulation whilst minimising (the costs of) the immobility represented by storage; commodities idling in the warehouse (ibid.: 636). This in turn relates to capital's expansionary impulse, which necessitates ever-greater quantities to be pushed through the supply-chain, creating additional pressure on one's ability to manage them. The most interesting properties however are the final two: reliability and flexibility. They refer, on the one hand, to the crucial importance of smooth and uninterrupted circulations of value, and, on the other, to the need for commodity flows to be responsive and agile as a result; to get the right components to arrive, rapidly, in the right place, at the right time, and to be able to respond rapidly to changes in prevailing conditions. These two capabilities will be examined in more detail in the following section, which brings the revolution in logistics back into an urban context, and thus into tense relation with the city's socio-political complexities.

Before moving on however, it is worth making a small note. Whilst we have, in the current section, followed other writers in using interchangeably the terms 'logistics revolution' and 'revolution in logistics', going forward a distinction between them is revealing of the dynamic by which logistics, as a militarily-derived way of knowing and doing, not only *revolutionised* the perspective on the firm, but was also *revolutionised by* its operations in the corporate sphere. Just as logistics taught the firm how to manage the frictions of circulation, the firm taught logistics how to orientate such knowledges both to saving and making money.

City Logistics: Calculative and Spatial Retrofitting

Logistics has been an especially important rationality in the (re)positioning of the city within not just a national but a global space of circulation. Drawing attention to the "increasingly global networks and metrics that define contemporary cities", Cowen (2014: 184) points to the emergence of two urban logistical forms: the 'logistics city' and 'city logistics'. Whilst

sharing the same underlying logic, the latter is distinguished from the former by the fact that it "acts on already constituted urban spaces, aiming to transform dense and congested cities into more controlled and efficient spaces of circulation" (ibid.: 181). Unlike the logistics city, which emerges from a form of violence that is explicit and total, aiming to build from scratch a perfect space of circulation, city logistics is a practice of *calculative and spatial retrofitting* which attempts to optimise circulation within a pre-existent and complex environment.

As eluded to above, late-capitalism is heavily dependent upon reliability, upon the smoothness and uninterruptedness of circulations. In a system of 'fast flows', "[t]he problem of disruption…takes on epic proportions" (Cowen, 2014: 96). In Danyluk's words, "In today's just-in-time supply chains, the failure of a single part to reach an assembly plant can bring several downstream operations to a standstill. As a result, *even a brief interruption to value's metamorphosis has the potential to precipitate a wider crisis*" (2018: 637. Emphasis mine). Supply-chains are therefore deeply troubled by the fact that "cities are ridden with forces that disrupt efficient flows" (Cowen, 2014: 180). As a space of synchronous circulations and socio-political life, the urban is a perpetual thorn in the side of logistical fantasies of seamlessness (*see* Rossiter, 2014). Rife with "labor issues" and "community issues", the city is an unending source of potential blockage (Crainic, 2006. *Quoted in* Cowen, 2014: 180).

Here we witness the resurfacing of that aforementioned socio-political anxiety associated with the city: in particular, the idea that even brief disruption of smooth circulations can unfold rapidly and unpredictably, leading to catastrophic loss or even to the unmaking of liberal society. As such, attempts to protect this economic model against disruption, such as the practice of supply-chain security, share with VSS a view of the domestic (especially urban) population as an inconvenient or moreover potentially threatening force to the

systems of circulation. Echoing Campbell's earlier criticism of Cold War civil defence, Cowen notes that "it is the security of *supply chains* rather than the people who live and work in the city that is the focal point of a logistics lens" (2014: 172). Of particular concern is the insider threat posed by those who work and circulate within logistical and infrastructural networks. Viewed as components in a highly delicate and interdependent system of rapid and valuable circulations, small acts of disruption can have far-reaching impacts.

The problem for logistics in this way is that urban spaces provide, alongside their ever-present promotions of speed, *opportunities for immobility and its projection as a form of resistance*. Approaches to industrial action and protest for example are increasingly diversifying from the act of withdrawing labour to various forms of 'counterlogistics': methods which utilise "sites of physical circulation as pressure points where mass movements can contest the violence of state and capital" (Chua et al., 2018: 623). Joe Allen, writing for the Jacobin Magazine, has called on more than one occasion for workers in the logistics industry – employees of companies like DHL and Amazon – to use their potentially advantageous position to unionise and agitate (*see* Allen, 2015; 2017). Furthermore, counterlogistics as a method has implications beyond the bounds of this sector, its scope broadening to render public and quasi-public infrastructures potential spaces of activism (*e.g.* Dyer & Wakefield, 2015). If systems and spaces of the liberal city function, increasingly, upon 'just-in-time' processes, then they may be more vulnerable than ever to acts of 'tactical acupuncture'. However, this is perhaps based upon a misapprehension of logistics and 'just-in-time' as premised upon smoothness and seamlessness. In fact, city logistics as a practice is meant specifically to take into account the inevitability of urban frictions. As will be explained in the following, this indicates a wider misunderstanding based on a binary view of circulation and disruption; strategy and tactics.

Intercepting and Internalising Disruption: City Logistics as Friction Management

In their study of the aesthetics of late capitalism, Toscano and Kinkle (2015) identify a risk – particularly in the way logistics and logistical spaces are represented in the arts and visual culture – of fetishizing not only the smoothness and anonymity of circulatory regimes, but also the relation between that smoothness and a moment of disruption or revelation. For them, the typifying example here is the powerful visual metaphor of a literal un-black-boxing of the anonymous shipping container, cracked open to reveal the disorder, pain and violence concealed within (2015: 200-1). The danger of this fetish lies in its failure to recognise the normality of disruption or disorder and the ways in which it is absorbed, deflected, or re-routed through logistical means.

As the work of Nicky Gregson (2017; Gregson et al., 2017) has pointed out, the industry of logistics itself is not nearly as smooth as it appears. Rather, it is characterised by friction, seams, and disorder. And if turbulence is part of the 'normal' functioning of logistics, then disruption alone does not guarantee political effect or transformation (Chua et al., 2018). Inherent to the art of 'supply-chain security' therefore is the attempt to intercept disruption even as it takes place, preventing it from 'cascading', from being amplified more widely. In this mode of security there is thus a spatial and material equivalent to Heath-Kelly's (2015) discursive disappearance of failure. As Kallianos (2018) warns, rather than necessarily leading to political redistributions, infrastructure's fragility may just as easily be 'concealed', with disruptions reworked back into the 'normal' functioning of the system and its governance. There must thus be a distinction drawn "between the internal and external aspects of infrastructural disorder". While the latter may constitute political exposure, the former "do[es] not unsettle the social order or generalized urban experience" (Kallianos, 2018: 771).

Logistics' response to counterlogistics is not exactly a 'counter-counterlogistics', since it adopts an approach the objective of which may be characterised as curbing emergent disruptions to an 'internal' state. Often going by the name of Business Continuity Management (BCM), this approach involves accepting to some extent that disruptive events will occur, but seeking to intervene so as to minimise deleterious impacts on circulation. Echoing the contemporary definition of emergency, BCM takes an all-hazards perspective on potential threat. As Folkers explains, "BCM regards any business interruption as potentially catastrophic, making it hostile not only to disruptions from natural disasters but also to disruptive phenomena in public life like strikes and demonstrations" (Folkers, 2017: 106). As such, one of the crucial aims is to intervene in disruptive events as they emerge so as to prevent the 'potentially catastrophic' from being realised. This intervention comes in the form of the re-routing of circulations along undisrupted routeways. As such, logistics is a form of calculative reasoning, but it is not only this; "it is also an essentially spatial and material practice" which functions by positioning and moving bodies and objects in space (Chua et al., 2018: 622; Danyluk, 2018). In particular, counterlogistical forms of political disruption are made difficult by the fact that logistics develops the capacity for circulations to be re-routed: "Attempts at resisting or disrupting circulation can be co-opted, contained, or absorbed—in the construction of redundant container shipping networks, for example, which give corporations multiple options for rerouting cargo around traffic bottlenecks or restive labor forces" (Chua et al., 2018: 623). The level of redundancy in a circulatory network, together with its flexibility or agility, therefore allows smooth circulation to continue uninterrupted even whilst disruption; moments of excess, take place (Neilson, 2012: 336).

Given the need for circulations to be re-routed as quickly as possible, the success of this operation depends upon forms of rapid or real-time analysis that carry out systems-thinking

continuously to monitor the status of the network: to establish, at any given time, where there is congestion or disruption, and where there is spare capacity. Danyluk for instance outlines the role of advances in computing, data processing and communications technologies in the ability to optimize circulation:

> "Advances in data-processing power and modeling capabilities made possible rapid comparisons of changing freight rates and allowed firms to optimize route choices, facility locations, and order quantities" (2018: 634. *See* Allen, 1997).

Furthermore, he continues, with the increasing use of internet and satellite communications has come the ability to calculate such factors on a "near-instantaneous" basis (ibid.; *see also* Bonacich and Wilson, 2008: 9–10). As these technologies of calculation and communication gather speed, it becomes possible to establish redundancy dynamically, re-routing circulations as disruptions emerge and before they are able to take hold and amplify themselves through the system. It is this process of real-time calculation and re-routing which indicates the unique character of logistics relative to the strategic view of system-vulnerability thinking. As Neilson argues, logistics may constitute a distinct diagram of power:

> "Logistical systems produce what Foucault called disciplinary and biopolitical forms of power, but they also produce their own specific form of power that at once generates value, imposes measure, and facilitates circulation" (Neilson, 2012: 331)

The context in which this diagram both distinguishes itself; *comes into its own*, and implicates itself within existing mechanisms and institutions of governance, has to do with a complex milieu of factors that together bring logistics – as a both militarily and corporately-inflected set of calculative and spatial practices – into the management of urban infrastructure. As part of a mode of governance which I will call 'logistical power', these practices constitute a form of knowledge and range of apparatuses that enable circulations to be re-routed, thus

allowing for the inevitability of disruptive incidents whilst at the same time not permitting disruption to have an effect on the system of circulation as a whole.

In the following section, logistical power is examined in greater detail in relation to the politics of urban citizenship and subjectivity. In particular, it will be argued that the logistical mode of power functions through a unique calculative viewpoint, differentiating it from the system-vulnerability thinking of VSS by giving the urban citizen access to a mobile and real-time perspective of the network, enrolling them not only to take responsibility for their own conduct but also to act in relation to the system of circulations itself.

All at Once: Logistical Perspective and Urban Citizenship

> "[W]hat does it mean for the city to be made in the image of efficient cargo flow? What does it mean for the urban to be designed and governed in the service of efficient economic exchange? What does this mean for questions of citizenship and the city?
>
> (Cowen, 2014: 167)

The integration of real-time calculative capacities in the ways described above implies significant changes to the diagram of VSS. This is best approached by thinking about the form of knowledge expressed in the rehearsals and enactments of Cold War-era preparedness, 'system-vulnerability thinking'. Logistics-as-power functions through a different calculative viewpoint. Beyond the *strategic* perspective of aerial bombing and 20th century systems modelling, to obtain a logistical viewpoint is not only to be able to see the system as a whole, but to be able to track its movements and fluctuations instantaneously. Logistics is constituted, in other words, by *the real-time and continuous communication of the strategic gaze* (*see* Virilio, 1989: 22-4). It maps not only the sum of positions and their relations but the sum of *mobilities and their intersections; loads and capacities; points of congestion and alternative routes*. As Virilio notes, logistics – as the logistics of perception – has always been about

image feeds as well as supply chains; it aims for a rapid and continuous stream not just of people and things, but of representations (2001: 186. *Cited in* Bousquet, 2018: 6).

Secondly, these same developments have implications for the nature of subjectivity and conduct as it pertains to urban populations. For Reid, as we have already mentioned, the prominence of logistics as a liberal principle leads to the inculcation of 'logistical life' as a certain responsibility to circulate, and to defend the right to circulate. In the context of smart urbanism's influence, it is necessary to emphasise the technologies of communication, and in-particular the real-time feedback loops, involved in this subjectification. For instance, Luque-Ayala & Marvin's (2016) study of Rio de Janeiro's urban control centre, the Centro de Operações Rio (COR) – an urban form constituted through a typical process of integration, combining the data streams of 30 formerly separate agencies through a platform operated by IBM (Kitchin, 2014: 6; Mattern, 2015) – highlights the contributions made by urban citizens, exploring the particular effects "when the conventionally hidden control room is opened to the city" (2016: 204). Occurring both through a heavy media presence embedded within the COR, and the frequent exchange of data between the control room's maps and the Rio public's geo-referenced smartphone apps, urban disruptions (from traffic jams and floods, to political protests) are not simply made visible to the populations, but are reported *by* them. Through these voluntary (though often passive) acts of reportage, urban citizens contribute to, or even become part of, the control room, multiplying its 'eyes on the ground' (Luque-Ayala & Marvin, 2016: 200-1). Citizenship is transformed through this process into the aforementioned "citizen sensing", whereby members of the public in effect "engage in the labour of being watched" (ibid: 201; *see* Goodchild, 2007; Gabrys, 2014).

By operating as a "distributed perception system", the Rio public are engaged as "a key component of the city's infrastructural operations" (Luque-Ayala & Marvin, 2016: 197). But,

more than this, the mutual opening up of the control room to the public *and vice versa*, means that citizens increasingly learn to view the city *from the perspective of the control room*, that is, as an integrated system of flows which is nonetheless always threatened by disruptions brewing beneath the surface; "always at a point of breakdown" (ibid: 197). In this way the view from the ground is increasingly filtered into or through the strategic view of the city as a kind of vital-but-vulnerable 'meta-infrastructure' (Luque-Ayala & Marvin, 2016: 195). Significantly, we might say that this also encourages a logistical self-perception, a form of citizenship that is defined by the responsibility to facilitate the city's circulations. It contributes to a variety of "conducts" which enable disruption to be managed and minimised: "changes in traffic routes, preparations for emergency response, avoidance of sectors of the city, or simply patience until services are re-established" (ibid: 200). As they go on to argue, this approach forecloses any possible politics of disruption:

> "Framing urban flows as a matter of civic rights, the COR's focus is maintaining the city flowing; its movement; its circulations. Even when the disruption itself is political, such as the anti-World Cup demonstrations, maintaining the flow as an operational requirement takes precedence over the very politics that are being made manifest" (ibid: 202)

It is notable again that, rather than disruption alone being fetishized into a *moment* of revelation, it is necessary to pay more attention to the processes – technical, but also social, political, moral, and so on – by which disruptive flows are contained, curtailed, absorbed or re-directed. In particular, the integration of the passenger into a data loop – wherein the passenger feeds in data which is then gathered, analysed, and presented back to her as the basis for her choices (*see* Lohr, 2012. *Cited in* Thatcher, 2014: 1775) – complicates de Certeau's (1984) claim on the tactical as that which is separate from and opposed to strategy. What we get instead is an uncertain hybridity constituted by the mediation of logistical technologies, knowledges, and desires. Neilson (2012: 37) in this way suggests we

imagine "that de Certeau's pedestrian walks in a contemporary city and carries a smartphone in her pocket. The use of such a device alters the experience of traversing the city not only by enhancing the pedestrian's capacity to pursue connections with a multiplicity of other sites but also in the way it registers her location and keystrokes, serves them up to strategy's databases, and then feeds them back to augment her interaction with the environment". Through the drawing-in of the urban citizen as both sensor and receiver of real-time calculations and visualizations, the form of conduct produced is orientated towards the system of circulations; the labour of detecting disruptions and re-routing (one's own) circulation.

In some sense, this kind of subjectivity acts in a not dissimilar way to biopolitical forms of (self-)conduct and responsiblisation: by engaging urban citizens to a much greater degree with the city's circulations, providing them with tools with which to measure their performance and contributions, one can encourage them to take responsibility. In the face of the uncertainty of such systems, this might contribute to an ontological sense of security, "foster[ing] an illusion of autonomy so that we can *feel* effective when we act" (Frost, 2010: 160)". The precise way in which it does this however is not only by providing citizens with the ability to measure their own actions, but also by making the system *as a whole* both visible (the strategic perspective) and also 'actionable' because it purports to enable meaningful interaction in real-time. In this way logistics' form of knowledge works through a particular form of speculative pre-emption which seeks to "render data *actionable*" (Amoore, 2011: 29), but does so with the specific demands of circulatory regimes in mind. The data which one is able to act upon is specifically concerned with optimising circulation and circumventing disruption, enabled by a calculative perspective that allows one to see the 'live' status of the system, and simultaneously to gauge our position and movements within it.

What we are talking about with logistics therefore is *circulation itself*, not merely as a means to other things (to travel, to distribute, to arrive), but as a sphere in its own right. Faced with Nicholas Negroponte's claim quoted at the start of this section, Massumi responds to the MIT Media Lab founder with the rhetorical question: "Why bother with gossipy cuff-links? Because they would connect. The titillation is less in the gadget itself, or in the goal of the gadgeting, than in the joy of connection" (1995: n.p.). Although it is most clearly realised in the kinds of fantasy mobilised in the discourse of 'smart', what Massumi calls the 'connection fetish' belongs to something broader than technological utopianism. It speaks to a form of power and governance which seeks simultaneously to facilitate, to make-resilient, and to extract value from, circulations.

Following the assertions made about logistics, this kind of joy is realised digitally, but also always spatially and aesthetically. If logistics concerns friction, then it also works through both representational and non-representational means of smoothing out, cushioning, insulating. As such, the penultimate section of this chapter will emphasise the material, sensory and affective character of logistics.

2.4. The Feel of Circulation: Logistics, Aesthetics, and Affect

> "The police is not the law which interpellates individuals…[i]t consists, before all else, in recalling the obviousness of what there is, or rather what there is not, and its slogan is: 'Move along! There's nothing to see here!' The police is that which says that here, on this street, there's nothing to see and so nothing to do but move along. It asserts that the space for circulating is nothing but the space of circulation"
>
> (Rancière, 2010: 37)

As Rancière has it, the maintenance of order is related to the function of 'police' not so much through an Althusserian 'hailing' – "hey, you there!" – but more via the declaration of the '(non-)event', the "Move along! There's nothing to see here!" which simultaneously

proclaims and denies. Though what Rancière refers to is something broader than the institution of the police, one can nonetheless draw comparison with the rationale for the foundation of London's Metropolitan Police force early in 19th century. According to Vitale (2017: 36), the idea of the Met. – established by Sir Robert Peel according to principles and methods experimented with, like aerial bombing, in the colonies – was for "a force that could both maintain political control and help produce a new economic order of industrial capitalism". Most interesting in this regard is the fact that this was accompanied, in 1824, by the introduction of the vagrancy laws (ibid.) – "An Act for the Punishment of idle and disorderly Persons, and Rogues and Vagabonds" (Vagrancy Act, 1824). Together, these strategies sought to push as many people as possible into paid labour, the spatial logic being that, the more people could be kept in circulation; on the move, the less they would congregate politically, and the less they would disrupt those very same valuable flows of which they were now a part. Further to this spatial logic, Rancière's slogan is aesthetic. The disruption exists, but it is not to be seen (it is not sensible); it is to be moved on from. The idea of 'friction' and its management must, therefore, be taken not only as a concept or metaphor. It must, in other words, be taken quite literally, as a sensation, a roughness affecting the process of seeing, hearing, touching, smelling, and so on.

It has already been pointed out, in the study of UK preparedness exercises, how the uncertain future of emergency is brought into the present both as a set of narratives, and as a range of feelings; emotions and sensations (Anderson & Adey, 2011). The enactment of emergency situations – and the building of 'resilience' in which such practices are implicated – involves the enactment of both plot and 'atmosphere' (see Gandy, 2017). As Anderson and Adey explicitly state, this kind of work builds upon that of thinkers such as Massumi, whose (2005) analysis of the Bush-era 'colour-coded terror alert system', launched by the DHS in 2002, posits it as a governmental technique based upon the 'calibration of public anxiety'

through 'affective modulation' (2005: 32-4). Like Rancière's contrast between the "hey, you there!" and the "Move along! There's nothing to see here!", the alerts did not call upon its audience to take up a particular subject position. They "addressed not subjects' cognition, but rather bodies' irritability"; "Any moment of reflection that might come would come after, in discussion or retrospective review. The system addressed the population immediately, at a presubjective level", targeting "the generic 'material quality' of human life" (ibid: 32-3; 46).

It is noteworthy that Massumi views the 'techniques of attention' associated with the media – "in particular as they disseminate themselves more widely and finely through the social field, assisted by miniaturization and digitization" – as being an important factor in the propagation of a particular "*affective tone* or *mood*" (ibid: 44; 41), thus highlighting the entanglements of ICTs, matter, aesthetics, and affect. Likewise, Kitchin and Dodge (2011) have emphasised the mutual constitution of 'code' and 'space' in the urban deployment of 'smart' object and systems, whilst Zehle (2012) and Ash et al. (2018) have discussed some of the affective and embodied dimensions of digital interfaces.

If we can examine both resilience and smart urbanism through the lens of aesthetics and affect, what, we might ask, is the value of a logistical angle? There are two main points to be made. First, I would argue that a logistics framework, with its aforementioned duality of heritage, enables us more easily to analyse the affective and aesthetic dimensions of urban governance outside the bounds of the exercise, in the everydayness of 'timespace' (May & Thrift, 2001) and 'code/space' (Kitchin & Dodge, 2011) which is nonetheless shaped by the potential for emergency. Second, logistics bears an explicit and integral link to processes of circulation. It does not need spatialising because it has always had concerns of space at its heart. The affective and aesthetic dimensions of logistics are thus tied to experiences of

movement. These ties are developed significantly by Virilio's (2005a) ideas concerning what he calls the 'transport revolution'. For him, this phenomenon has involved not just the familiar notions of speed, acceleration, and 'time-space compression', but also processes and technologies of aerodynamics, cushioning, suspension, and so on, which seek to make movement into a comfortable, smooth, seemingly controllable experience; one in which the visual spectacle of movement, or 'dromoscopy', comes to dominate other less comforting sensory phenomena. Expanding upon Massumi's case then, the presubjectivity of logistical cues aim not only for 'activation' but also for *mobilisation*, militarily, aesthetically, spatially. The logistical state of alert is that of a readiness to move on.

Given the points outlined in the sections above, the conclusion to this chapter will put forward a tentative modification of Collier and Lakoff's (2015) conceptualisation of VSS, suggesting the coexistence of another diagram, logistical power, that governs not only via the protection of vital systems but also specifically via techniques of rapid response and real-time re-routings of circulations which offer the potential to govern them, together with their frictions and disruptions, iteratively and from within.

2.5. Conclusion: From Vital Systems Security to Logistical Power

In tracing the relations between circulation, emergency, and urban governance, this chapter and the last follow up on Collier and Lakoff's (2015) conceptualisation of VSS in order to elaborate upon it, and to propose a number of small supplements and augmentations. To conclude this chapter then, we put forward a new diagram, albeit a diagram closely intertwined with VSS. Although this diagram might be termed 'logistical security', I have elected instead to call it 'logistical power' in recognition of the fact that it is characterised by a duality of military (security and resilience-focused) and corporate logic; a composite of risk and opportunity (Fig. 5).

Tentatively, we might classify logistics as a form of power whose **moment of initial articulation**, though inseparable from developments in business logistics and computational methods of systems thinking in the post-War period, can be identified as the late-20th and early 21st centuries up to the present moment: a period in which logistics has become heavily influential to the hopes of a city capable of calculating complex circulations and responding rapidly to disruptions, balancing a need to be 'resilient' with an ambition to be 'smart'.

Like VSS, it holds, as its **object**, those critical systems of circulation which produce and protect modernity whilst being vulnerable to potentially catastrophic events. However, logistics tends to see such systems as supply-chains, and thus as a sphere of value as well as risk. It is therefore characterised by anxiety concerning the socio-political forces of disruption inherent to (urban) life, including circulatory interminglings and counterlogistical political methods which have the potential to hinder flows of value.

The **aim** of logistical power thus expands that of VSS in that it sets out both to secure the functioning of systems that are essential to modern life specifically in the face of unpredictable, fast-flowing, amplificatory disruptions to circulation – emergencies that unfold and require ever-faster forms of calculation and coordinated action – and to optimise their everyday efficiencies, seeking out opportunities to extract added value.

This kind of action is in turn enabled by what I will for the time-being call logistical thinking, a **form of knowledge** which, like system-vulnerability thinking, attempts to attain knowledge about the interdependencies of infrastructural circulations, and to model the vulnerability of the system as a whole through the *juxtaposition, connection, and (re)combination* of the vulnerability of its individual elements (Collier, 2008: 231-232), but

which furthermore looks to do so on a *continuous, integrated and real-time basis*, such that disruptions can be detected, met, and circumvented as they emerge.

As opposed to VSS, which focuses primarily on the practice of preparedness – rehearsal, simulation, enactment – logistical security shifts the emphasis onto **apparatuses** of rapid response: the actualisation or triggering of potential networks (networks-in-embryo), the deployment of 'smart', real-time modes of communication, and the enrolment of the population via 'citizen sensing'. However, given the aesthetic and mobile character of logistics, such apparatuses are not purely technological, having to do with the management of sensory and spatial processes.

The elucidation of this diagram will, it is hoped, contribute to a better understanding of the politics of logistics as a calculative form of power in the governance of urban circulations, urban emergencies, and urban populations.

Form of Collective Security	**Sovereign State Security**	**Population Security**	**Vital Systems Security**	**Logistical *Power***
Moment of Initial Articulation	17th century: absolutist states	19th century: social insurance, public health	Mid-20th century: nuclear preparedness	Late-20th century/Early 21st century: Resilience; Smart Urbanism; Business Logistics
Aim	Strengthen and secure sovereignty against internal and external threats	Manage regularly occurring threats such as endemic disease, poverty, and infirmity	Secure the functioning of systems that are essential to modern life in the face of unpredictable but potentially catastrophic threats	Render systems that are essential to modern life resilient in the face of unpredictable, fast-flowing, amplificatory disruptions, and capable of

				capitalising on opportunities for value-added
Object of Concern	Bases of sovereign power: military strength, internal order, wealth	Social processes: economic production; circulation or exchange of goods and people; demographic processes	Vital systems: webs of industrial production, critical infrastructures, governmental apparatuses	Vital systems as socio-technical and commercial systems of circulation: Supply-chains; networks of distribution; critical infrastructures
Form of Knowledge	Raison d'etat: knowledge about balance of power, domestic bases of sovereign power	Social sciences: knowledge about the regularities of collective life such as rates of birth, death, employment, poverty and crime, and economic cycles	System-vulnerability thinking: knowledge about interdependencies and vulnerabilities of vital systems	Logistical thinking: continuous, integrated and real-time monitoring of circulations and emergent disruptions; dynamic re-routing and capacity management; Total Cost Analysis
Characteristic Apparatuses	Diplomatic and military measures to increase internal and external security; mercantilist policies to increase sovereign wealth	Social insurance; infrastructure development; macro-economic management; public health; urban planning	Governmental preparedness; vulnerability reduction; emergency management	Rapid response; networks-in-embryo; 'smart' technologies; citizen sensing; friction management

Figure 5: Preliminary outline of logistical power relative to forms of collective security (source: author, adapted from Collier & Lakoff, 2015)

3. Introduction to the Case Study: The London Underground

3.1. Introduction

This short chapter is intended to explain my reasoning for the choice of the London Underground (LU) as a case study for exploring the ideas and questions posed through chapters one and two.

A number of initial reasons relate to matters of pragmatism and (somewhat ironically) 'logistics' in the common usage of that term. Being based in London and restricted in time and budget, the London Underground was an object of study circulating right under my nose. Entering the field required just an hour or two of spare time, and only a small amount of money. Undeniably, this accessibility does not mean that the Underground was altogether an easy object of study. It may be simple to access, but it is once one is inside the space (conceived as a network) that certain obstacles – to be discussed in chapter four – arise. Nonetheless, overall the Underground was considered a realistic object for research: interviewees with relevant experience and expertise were readily available in London, site visits were possible to TfL headquarters, and other materials could be accessed online, and through facilities such as the London Transport Museum, based across two sites in Covent Garden and Acton.

Beyond these practical considerations, the LU gives us a unique vantage point from which to view the theoretical issues raised in the previous chapter. This vantage point can be divided into six different aspects, each of which is outlined below.

3.2. Temporal: the Construction and Maintenance of Infrastructural Subjectivity

The LU is one of the earliest examples of mass rapid urban transportation, and the very first metropolitan railway system. When the Metropolitan Railway (now constituting part of the Metropolitan Line) opened in 1863 between Paddington and Farringdon, what had previously been considered a laughable concept – of digging up huge tracts of the urban landscape, covering them with many miles of track and tunnel, and then channelling through those dark and absent spaces actual urban residents – became a real absurdity (*see* Pike, 2005).

Other metros followed around the turn of the century – in Budapest and Glasgow in 1896, Chicago in 1897, and Paris in 1900 – however, even in October 1904, when the New York City subway took its first trip, Höhne (2015) documents the carnivalesque excitement that surrounded the introduction of such means of urban mobility. He also draws notice to the fact that, for systems of transportation in particular, building an infrastructure is not solely about the construction of the technical thing. He remarks that such sociotechnical systems involve processes of subjectification; they "bring about new forms of governance, interaction, experience and knowledge, sometimes even resulting in new and powerful modes of collective and individual subjectivity" (2015: 313). Infrastructures do not arrive as settled and accepted. Their 'maturity' depends upon forms of governance, knowledge, and conduct through which they come to be perceived as a non-event (ibid: 314; *see* Gandy, 2005; Graham & Marvin, 2001).

The same is true for the Underground. By now, it is something which residents of London tend to take for granted, but it is important to remember that this was not always the case, and, moreover, that its contemporary mundanity is something that has been 'learned' and continues to be worked upon in various ways (*see* Star, 1999: 381). Graham and Thrift

(2007) point out the vital and often underappreciated role of maintenance in ensuring the continuity of urban life, but again, this should not be seen only as a technical task. What is being maintained is also a certain set of perceptions and ideas; it is *a maintenance of belief*.

And, finally, the Underground is a sociotechnical system whose existence, in some sense, is not confined to London as a geographic area. It is, even at this very moment, being exported, both formally and informally, to other cities looking to model their own metro systems upon the original blueprint: not only the trains, rails, and tunnels, but also the technologies of communication (from signalling systems to wayfinding), and the methods of passenger regulation and policing. This relates to the next aspect: the symbolic role of the LU in the signification and reputation of London across local and global scales.

3.3. Cultural & Economic: the LU as Symbol and Brand

Around forty years after the opening of its first line, the Underground began to swap its more formal title for the local nickname, applied first to the Central Line from around 1901, of 'the Tube' (Thacker, 2007: 102). The familiarity of this name is representative of a broader centrality of the system to not only the economic functionality, but also the identity and reputation of London locally and globally.

The identity of 'Londoners' is shared to a significant extent through anecdotes based on the Underground – tales of awkwardness, conflict, or, perhaps less commonly, kindness in encounters with fellow passengers, or stories of frustration with disruptions – through feelings of know-how (accompanied by the ridicule of those 'tourists' and outsiders who do not use the system in the 'correct' manner), and, finally, through the familiarity of a particular aesthetic, whether via the proliferation of the 'Underground' roundel on T-shirts and mugs, or, in my case, the rendering of the Tube Map as a poster mapping British musical artists which hangs on my bedroom wall. Consequently, when we think about

subjectification or conduct in relation to the Underground, we cannot think only in terms of rational action, of stick and carrot, or even necessarily of responsibility. Though fines and incentives will always play their part, behaviour towards 'the Tube' is undergirded by much less easily measurable feelings of pride, desire, frustration, and so on; by a wide range of emotions and sensations (*see* Larkin, 2013).

In addition to this local identity, the Tube is a prominent symbol for London worldwide. As such, it plays an important part in the 'branding of place', helping to assert the achievement of global city-ness (*see* Coaffee & Rogers, 2008). The Underground's performance – in terms of efficiency, safety, and security – is thus inextricably linked to measures of London's performance relative to other cities around the world, both symbolically, via the effects of 'reputation', and in terms of direct economic impact. Again, this is as much about perception as it is about base facts. From a resilience outlook, it is less about preventing all incident, than it is about how one responds, absorbs, and adapts to limit the damage. The image of security is, as always, just as crucial as its reality (*see* Boyle & Haggerty, 2009).

Given the assertion made in the literature review concerning the more-than-technical nature of urban systems, the following two sections delve deeper into the symbolic aspects of the Underground in relation to questions of urban politics, morality, and risk.

3.4. Social-Political and Moral: A Civilising Agent?

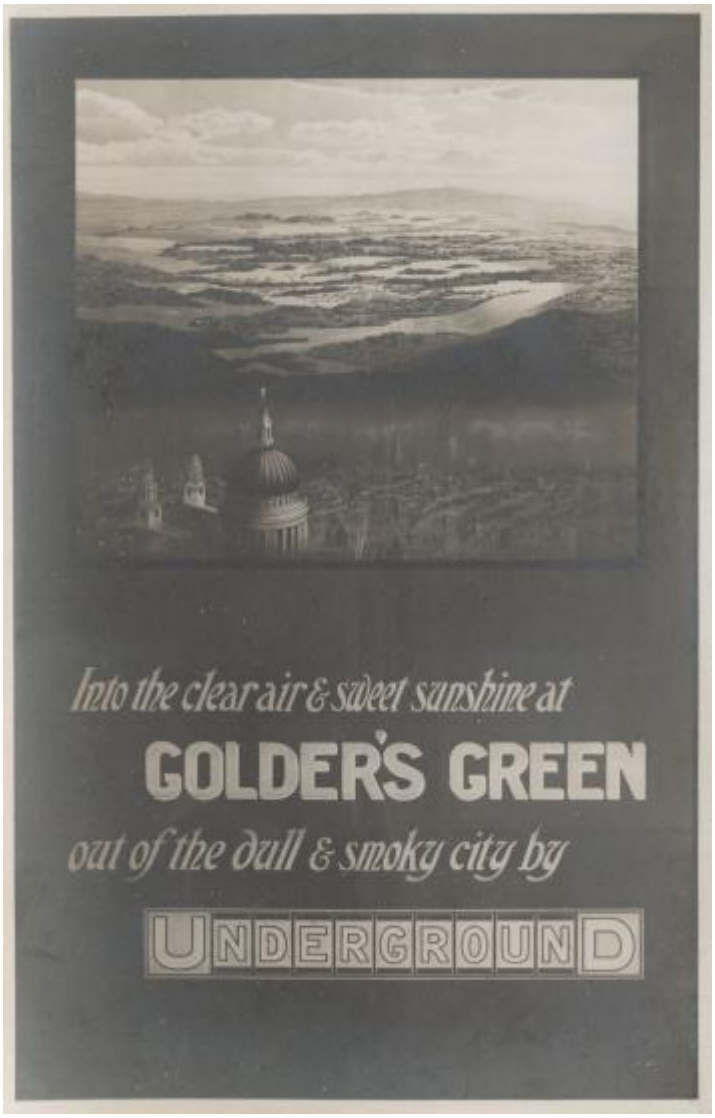


Figure 6: Metropolitan Railway poster, 1911 (source: LTM Collection; Thacker, 2007: 125)

The real theoretical intrigue with the case of the Underground begins with the realisation that it is a system which has always had a somewhat troubled relationship with the urban itself. Whilst we think of it as an 'urban railway'; a means for getting *around* the city, it is undeniably the case that the London Underground originated just as much as a means of getting people – or a certain class of people – *out of* it; a means of escape or dispersal. This motivation is best expressed in the early 20th century promotion by the railway companies

of the suburban territories known as 'Metro-land': planned areas such as Hendon and Golders Green (Thacker, 2007: 104). Indeed, in the 1920s it was Metropolitan Railways itself – under the aegis of Metropolitan Railway Country Estates Ltd. – that built settlements such as Neasden, Ruislip and Wembley Park (Metropolitan Railways, 1924. *Cited in* Thacker, 2007: 108). With the Underground, the middle classes could benefit from the density of the city, and then, come 5pm, they could quickly retire to the peace and quiet beyond the built-up centre.

The tunnels of the Underground in this sense connect and reveal by concealing; by displacing or postponing the gaze (*see* Krajina, 2013). The urban tunnel is the self-enclosure of the façades in Lefebvre's description of Haussmann's Paris which, as part of the vista, are built to attract but also to divert the attention:

> "Built to be seen (and to allow one to see out, from balconies, windows and openings), the façade is a lie. What lies behind this show, under this decoration? What are these rigidly straight, perspectival, streets hiding?" (2003 [1974-5]: 156)

If the façade conceals by creating a display at its surface, the tunnel plunges into darkness by promising the light at its end; the nostalgia and landscaping of Metro-land. Everyday life here is "order[ed] into perspective"; a 'staging' which curtains-off its undesirables – "the *scene* determines the *ob-scene*" (ibid: 156). The straightening of the city and the arrangement of the gaze into perspectival vectors. This idea will be returned to in a subsequent chapter. But suffice to say that the possibility of the Underground as a means to order the city was recognised explicitly by perhaps its greatest individual influence, Frank Pick – the Chief Executive of the London Passenger Transport Board from 1933 until 1940 – who, in a 1935 speech at the Royal Society of Arts, stressed the system's potential as a civilising agent for Edwardian London (Long, 2011: 28).

On the one hand, we can interpret Pick's ambition as a call to unite the city's population; bringing people into interaction with one-another and creating spaces of appearance or agonism (*see* Pike, 2005: 44). On the other, we can conceive of it as a Haussmannian plan; a particular ordering of circulations into a network that not only excludes certain, less desirable elements, but also prioritises the continuity and calculability of circulation above the possibilities of sociality and the political. Even if we take up the latter interpretation, it is surely the case that the Underground, as a strategic urban order, has always been subject to tactical acts of subversion. Its relation with the urban remains ambiguous and incomplete.

3.5. Risky & Resilient

The founding ambiguity between the Underground and the city can be seen to develop into an equally ambivalent position with regards to risk. As I will explain in greater detail at a later stage, in the early decades of the Underground the space was deeply associated – despite the framing of its function as a means of escape – with the very worst, *lowest* potentials of the city for dirt, crime, and sexual promiscuity (Pike, 2005: 26; 33-6). This is a reputation which, to some degree, persists today. In another sense, however, the Tube has developed associations with resilience, not primarily conceived as a technical but a cultural capacity: the 'resilience' of the British and of Londoners in particular. This is linked historically to the popular mythologies which developed out of the Second World War and the Blitz, especially the famous images of London residents sleeping head-to-toe on the platforms of Underground stations. Long notes how this military aspect of the deep-level Tube was in fact key in influencing the construction of the Moscow Metro as a deep subterranean (rather than shallow cut-and-cover) system. Shortly before the Moscow Metro was built, a delegation came to London, led by Nikita Krushchev, and in his memoirs the Soviet statesman recalled telling planners to "[k]eep in mind the possibility of war…and

you'll see that the tunnels with their reinforced shielding and buttressed walls would make excellent bomb shelters" (*quoted in* Long, 2011: 126). Without displacing these associations, risk events of recent decades have laced the Underground with the possibility for emergency or disaster. The Tube has come either to be targeted from the outside (the IRA campaigns of the 70s and 90s; the 7th July 2005 bombings), or to damage itself from within (the Kings Cross fire of 1987 in particular). It has become linked, more than most spaces, to risk and terror, as well as to the presence of 'exceptional' security practices, as exemplified by the shooting of Brazilian migrant Charles de Menezes at Stockwell station on 22nd July 2005.

Finally, the LU seems to embody, among its representations and experiences, a certain disparity between a notion of smoothness and speed, on the one hand, and an all-too-obvious reality of delay and overcrowding on the other. Is this a binary between false and true; idealism and reality? It seems to be more complicated than this. One side of the binary appears to exist within the other; to be folded into it. This has to do, I think, with the fact that the Underground, as a hugely ambitious urban infrastructure, has always been (under)grounded in the project and promise of liberal modernity: the hope of being freed from the 'tyranny of distance' and entered into unencumbered, frictionless circulatory life. As Thacker suggests, for instance, the idea of the Underground may be conceived through an adaptation of Ian Carter's (2001: 4) assessment of the railway – the central symbol of modernity in the 19th century – as "the central symbol of *urban* modernity" (2007: 102). Yet, it is, at the same time, evidence of the failure of such promises; the persistence of friction, turbulence and accident. Unlike the equivalent projects in sewerage and water networks, these shortcomings cannot be so easily put out of sight; they are lived every day by the city's residents and visitors.

The Underground is thus a coexistence of opposites: it is both deeply quotidian and (potentially) catastrophic; a source of both pride and frustration; it is fast and slow; new and old; colourful and drab; comforting and anxious. All these conflicting events, histories and memories are infused into the everyday experiences of the network; into its physical and emotional architectures, into its atmosphere(s).

3.6. Spatial: Subterranean Infrastructure(s) and the Problem of Jurisdiction

> "Nobody is really in charge of infrastructure"
>
> (Star, 1999: 382)

There is one aspect which I have yet to mention explicitly if only because it runs through all the other aspects, and because it will be discussed in detail in the empirical chapters. This is the subterranean nature of the Underground environment. Or, rather, since in fact much of the network remains above ground,[6] it is the subterranean *identity* of the Underground; the fact that most people consider it a subterranean space. Although, as we have already noted, it is by no means unusual for urban infrastructure to be situated underground, the burial of transportation is a special case which heavily colours the aforementioned processes of subjectification, the atmosphere of the space, and understandings of risk.

Crucially, going under the city means that the Tube, to an even greater extent than infrastructure in general, exceeds straightforward, territorial notions of jurisdiction. Spatial divisions often used to allocate responsibility for public services, such as boroughs or counties, are of only limited use. Furthermore, the Underground could certainly be classified as one of Perrow's 'closely-coupled' systems. Initially, this gives rise to an argument against my choice of a single case study. For some, this is inappropriate because such systems are

[6] As Long (2011: 68) points out, the London Underground is really two separate railway networks, one predominantly above ground, the other below.

complex and interdependent and, as a result, the question of their governance is one that spreads across institutional boundaries. From this perspective, studying the Underground – especially in the context of risk, disruption, and 'cascading failure' – necessarily means studying the relations between it and other infrastructures (other modes of transportation, but also other 'vital systems', from healthcare, to gas, water, and sewerage).

However, I argue that such a criticism tends not only to lead to undue focus on the 'technical' nature of failure, but also to confuse the space that is the Underground with a singular, enclosed system. The London Underground, I would contend, is not one infrastructure but many. Whilst it has one central system, this is supported by numerous others, the 'infrastructure of infrastructure' (Simone, 2015). Increasingly it is what Kitchin and Dodge would call a 'coded assemblage', made up not just of trains on tracks but also a plethora of other systems such as electrical power, ventilation, and communications, all of which depend to varying degrees upon a range of coded *objects* and *processes* (2011: 6-7). Moreover, in the range of possibilities that animate it, the Underground, even if operated by a singular agency in TfL, frequently draws in a large number of other actors, from public organisations such as the London Fire Brigade (LFB), paramedics, and the Metropolitan Police, to private firms such as advertising companies, software providers and – an important part of what follows – logistics specialists. In some cases, as we will see with the British Transport Police (BTP) and the Emergency Response Unit (ERU), infrastructure invokes its own unique kinds of institutions intended to take particularly mobile, flexible, and multi-agential forms.

This contributes to a lack of clarity when it comes to the Underground's ownership. The system has undergone a series of changes to the status of its ownership and management over the course of its history. Notably, the early network originated in a piecemeal fashion

as a result of a number of private initiatives – what Long describes as a "rampant commercial free-for-all" (2011: 14) – and it was not until the 1929 Labour government of Ramsay MacDonald that the companies were united and nationalised, in 1933 coming under the authority of the newly-formed London Transport (ibid: 18). Despite a number of smaller alterations in the proceeding decades, the next major shift did not occur until 2000, with the formation of TfL as part of the GLA. Initially, London Underground was operated separately, via a Public-Private Partnership (PPP), but was passed in full into TfL's remit from 2008 when one of the partners, Metronet, went into administration (TfL, n.d. [a]).

However, what is more important than these formal statements of ownership is the extent to which, in the context of both resilience and 'smart' governance, such formal distinctions tend to become increasingly hazy. In particular, as central government funding for TfL and other public services and infrastructures has become scarce in recent years, this has led to numerous flows across the binary of 'public' and 'private'.

3.7. Financial: the Crisis of Public Sector Funding

On 10th April, 2019, car users whom usually travelled to work by crossing over the Thames via Hammersmith Bridge in West London found that they were suddenly no longer able to do so. The bridge had been closed to traffic on an indefinite basis, citing severe safety concerns arising from an inability to carry out routine maintenance. This was in turn attributed to funding cuts suffered by TfL since the global financial crisis of 2007/08, which has included the gradual removal, since 2015, of central government funding for day-to-day operations, meaning it is under pressure to fund itself entirely through its own revenues (Topham, 2015; TfL, 2019a). At the time of writing, the bridge remains closed. The shock of this experience serves to illustrate not only how, particularly in cities of the Global North, any such failure of infrastructure can cause significant consternation, but also how the

political and economic context of public funding cuts and austerity measures has impacts for the sphere of urban infrastructure in ways that in some cases are only just beginning to become evident. In particular, it demonstrates to us the fact that the London Underground, as a space funded and managed by TfL, is also under unprecedented financial pressures. In short, the operation and strategy of TfL and LU has in recent years been set to the tune of scarcity.

The current thesis is far from a study of economic policy, but it is nevertheless the case that the discursive and material realities of funding cuts ingrain themselves deeply into the current project, forming a background that frequently and inevitably penetrates into the forefront of the analysis. As will become clear, a central claim here is that such a context of ongoing crisis or scarcity by no means limits decisions, impulses, desires and worries to a narrow or myopic reactionism or pessimism. By now well-trained in the rhetoric and attitude of a reinvented and reinvigorated 'bulldog spirit', the wide variety of key actors and institutions are careful to state – for instance, in the 'forewords' of performance reports and strategic planning documents – the hardship of the situation whilst in the very same moment resolving to identify the novel opportunities arising out of the rubble: from particulars such as new ways of structuring an organisation, to more nebulous new ways of thinking and knowing, and, especially, a new openness to creativity and technology. Risks, in short, are tied closely to opportunities, such that the boundary between 'bouncing back' and 'moving forward' is hardly perceptible.

The context of austerity is not necessary to the patterns which I am trying to describe, but it has certainly brought to the surface what has long bubbled beneath. As such, it is crucial for elaborating upon the theory of logistical power introduced in the previous chapter. Austerity paves the way for a given discourse – what I will call 'doing more with less' –

through which logistical power is articulated. But this is also representative of a more broad-based set of ideas; a combination of risk aversion and value extraction addressed to circulatory systems.

The above observations about the nature of the object of study, its particular ontology, also lead, of course, into questions of epistemology – of how one can best critically analyse such a unique case. This is the task of the next chapter, which addresses issues of methodology and method.

4. Methodology & Method: From Critical Discourse Analysis to a Critical Approach to Logistics

4.1. Introduction

The following chapter seeks to provide both a theoretical and practical foundation for the subsequent empirical sections of my thesis. It does so by grounding my research methods within a methodological framework that seeks to find an appropriate balance between discourse and practice in the context of what I am calling logistical power. Given the concern of my project with logics or rationales of governance and calculation, I begin by thinking within a discursive framework as a methodological standpoint with the potential to reveal underlying patterns among 'texts'. This allows me both to make use of the aforementioned accessibility of documentation and interviewees, and to peak beneath the often mundane and apolitical surface of such texts. Moreover, it enables me to study the role of 'texts' within the space of the Underground itself; that is, those representations, abstractions, and signs which mediate people's interactions with urban systems.

More specifically therefore, the methodological framework is developed out of a critique of Critical Discourse Analysis (CDA) – a recent outgrowth from more orthodox discourse analysis approaches which focuses on the 'hybridity' of discourse, its multi-semiotic forms (not only as language, but also images, sounds, and so on), and its dialectical relationship to moments of practice (policies, institutional arrangements, architectures etc.). The reason for starting with CDA is that it has been put forward, most notably by Chouliaraki and Fairclough (1999), as an especially appropriate approach for interrogating the socio-economic shifts of 'late-modernity'. Thus, they posit that the nature of 'discourse' has also shifted, becoming more flexible and multi-faceted. It is no longer predominantly linguistic, instead amalgamating a variety of media, and a single 'text' is frequently produced through coalitions of different voices representing a variety of institutional backgrounds and interests

(public and private). The usefulness of this set of ideas is demonstrated in the context of my case study by the importance of multi-agency working and communications, but also, as I will argue, by the spatial and material concerns of managing circulations.

Building on Chouliaraki and Fairclough's ideas, the chapter sets out, initially, towards what I call a 'discursive regime of logistics'. In a similar pattern to the literature review, this attempts to negotiate between work that has analysed the discursive aspects of (in)security and resilience on the one hand, and, on the other, that which offers a critical perspective on the discourses helping to constitute and justify the practices of late-capitalism – particularly the increasing use of software and the utopian aspirations of the 'smart city'. Reflecting the need, according to a logistics framework, to consider both military and commercial aspects, it then picks up on the observations of those, such as Cowen (2014), who find logistical governance to be bolstered by a particular narrative which frames uninterrupted circulation as imperative not only to systems or business strategies, but to life itself.

Furthermore however, in the specific context of the LU, the chapter begins to move beyond even a 'critical' discursive approach, and towards something more attuned to this unique environment. It is argued that this environment is governed through a particularly dense intertwining of the material and the semiotic, a complex arrangement of discourses and practices. This arrangement needs to be unpicked via a multi-method approach, but also by an approach that takes account of the particularity of mechanisms involved in logistical governance. Notable in an epistemological context is the deployment of language, matter, sensory cues and data-driven calculations first and foremost in the service of navigation, wayfinding, and flexible re-routing, a particular kind of semiotics that seems in its immediacy and orientation (always geared towards circulation) to be non-discursive; non-representational. As such, I conclude the chapter by committing to study the Underground

through an approach that includes, but also goes beyond, the study of its 'strategic' representations – countered by 'tactical' realities – focusing instead upon the fragmentation and mobility of the strategic into multiple, flexible, distinctively logistical forms.

We begin by briefly setting out the role and study of discourse in relation to the disciplines of politics, geography, and security studies, focusing in particular upon the opening up of these disciplines to discursive approaches, and the corresponding broadening of discourse studies into more diverse, critical methodologies.

4.2. Politics, Language, Space & Security: Discursive Approaches to Resilience

The recognition and study of discourse in Western political thought stretches back as far as Aristotle's work on classical rhetoric as the art of persuasion through which arguments were put forward as to the future direction of the Ancient Greek city-states (Aristotle, 1954; Dunmire, 2005; 2012). However, modern social science tended to relegate discourse to a peripheral position. The discipline of geopolitics, for instance, set itself up as representing a "supposed objective materialism" which "addresses the base of international politics" (Ó Tuathail & Agnew, 1992: 191), thus juxtaposing the 'hard facts' of space and territory against the vague and deceptive world of language and ideas (*see also* Agnew, 1994). It is thus only more recently that a comprehensive body of work on discourse and its relationships to security and space, concepts previously held captive by state-centred realism, has emerged in the form of constructivist-inspired approaches. This includes the oft-referenced 'linguistic turn' in security studies – pioneered most famously by the Copenhagen School – and its claim that 'security' was not purely a thing 'out there', but a discursive construct whose reality could be brought into being via the securitising 'speech acts' of political agents (*see* Waever, 1995; Buzan et al., 1998; Macdonald & Hunter, 2013).

The idea of 'risk', according to this constructivist perspective, depends not on objective calculations of likelihood and impact, but upon numerous value judgements – what counts as '*critical* infrastructure', for example? – and decisions over what (or who) is deemed 'risky' or threatening (see Kristensen, 2008). Similarly, the previously discussed 'resilience turn' can be thought of in discursive terms. After all, in Heath-Kelly's (2015) analysis, 'failure' is not considered to be an objective fact 'out there'; it is rather something which can be talked out of being, disappeared through the invocation of a narrative of resilience. More broadly, resilience as a discursive entity can be seen as altering (differently constructing) our realities by shifting our attitudes towards radical uncertainty and friction from 'shocks' or abnormalities which catch us by surprise, to unexpected events which are nevertheless part of the normal, accepted nature of existence, and with which we are ready to cope; to adapt to; to learn and grow from.

It is however worth noting, as Williams (2003) does, that securitization theory remains tied to a state-centric, Schmittian legacy – the definition of interior and exterior; 'us' and 'them' – even as its method takes us away from the realist tradition. Following this legacy, it remains most common to employ discourse analysis to examine individual political elites, dissecting their landmark speeches as representative of the intentions, justifications, or underlying rationales of an explicitly political institution such as the state (*e.g.* Dunmire, 2005 on George Bush Jr.'s Cincinnati speech on Iraq). As has been pointed out by Chandler's (2014a; 2014b) work especially, resilience-thinking tends, paradoxically, towards a form of governance that to some extent shuns attempts to control, or, arguably, even shape reality. At the very least then, resilience begs thinking about discourse in more diverse terms than securitizing 'speech acts'.

A range of critical approaches have recently begun to draw attention towards spheres of action beyond the state, opening up political discourse on two interrelated fronts: first, the question of *what counts as political discourse*, and, second, that of *who (or what) produces it*. Thus – albeit still framed in relation to state actions – Jennifer Milliken (1999: 240) suggests the need for discursive inquiry in International Relations to address the influence of the 'everyday' via two broad approaches: firstly, through the analysis of popular culture, and secondly through an anthropological approach. A similar set of needs informs the work of a group of scholars loosely gathered under the label of Critical Discourse Analysis (CDA). Originally comprising five founding members – Teun Van Dijk, Ruth Wodak, Norman Fairclough, Gunther Kress and Theo van Leeuwen – the CDA group sets out to study discourse as social practice, "impl[ying] a dialectical relationship between a particular discursive event and the situation(s), institution(s) and social structure(s), which frame it: The discursive event is shaped by them, but it also shapes them" (Fairclough & Wodak, 1997: 258. *Quoted in* Wodak & Meyer, 2015: 6). As such, CDA is concerned with relationships between discourse and power: "the way discourse (re)produces social domination…and how dominated groups may discursively resist such abuse" (Wodak & Meyer, 2015: 9). Texts are viewed as "sites of struggle" through which meaning is contested via acts of identification, categorisation, juxtaposition, and ordering (ibid: 12). Crucially, CDA is concerned with ideology, but not so much with ideology residing on the surface of society but specifically with "the more hidden and latent inherent in everyday-beliefs, which often appear disguised as conceptual metaphors and analogies" (ibid: 8). Key to CDA therefore is the task of "politicizing the language practices of everyday life and of social science inquiry by identifying and demystifying the dimensions of power and authority implicit in a range of texts" (Dunmire, 2012: 737).

In terms of *what counts as political discourse*, CDA greatly diversifies the potential objects of analysis. The political 'text' is no-longer restricted to the words of explicitly political actors (politicians, policy advisors, diplomats, etc.); it may be found behind and beyond the lectern, in 'practical' policy and strategy documents, architectural plans, news media, advertisements, films, T.V. shows, and so on. Accordingly the question of *who or what produces political discourse* is also expanded, coming to encompass a more flexible category of 'organic intellectuals' (Gramsci, 1971; Ó Tuathail & Agnew, 1992: 193) – from academics, scientists and journalists, to writers and film directors, and, most relevant in my case, planners, security practitioners, marketing gurus and corporate strategists. Vitally, and as will be expanded upon at a later point, texts are neither produced by any given individual subject, nor is any one text meaningful in isolation.

Being open to the diversity of political discourse becomes especially crucial in what Chouliaraki and Fairclough (1999) examine as the late-modern context, wherein discourse is increasingly characterised by both reflexivity and hybridity: a mixing of voices, genres, mediums, spaces and times. To give one basic example, we will soon see how a 'resilience' approach to security in the UK tends to emphasise the need for multi-agency working, planning and information-sharing, and partnerships which span public and private institutional divides and function across a range of scales. As such, texts increasingly reflect a large range of voices. Just because a document is produced by, say, the Home Office, it does not necessarily mean that its discourse will simply be the 'Home Office discourse'. It is not one voice but many. It therefore becomes increasingly important to examine texts for the ways in which they are multiply produced; for the traces of influence and power exercised through them.

In the following sections, we will elaborate upon the notion of late-modern discourse and its relevance for studying the London Underground. This will include a brief outline of how (critical) discourse analysis has been applied to the study of late capitalism and 'smart' cities, leading us eventually to discuss how logistical forms of power might be expressed and studied.

4.3. More than Language, More than Sign: Discourse and Practice in Late Modernity

> "It is an important characteristic of the economic, social and cultural changes of late modernity that they exist as *discourses* as well as processes that are taking place outside discourse, and that the processes that are taking place outside discourse are substantively shaped by these discourses"
>
> (Chouliaraki & Fairclough, 1999: 4)

One of the key debates surrounding political discourse analysis – and one which bears great relevance for my current project – concerns the question of a divide between discursive and non-discursive phenomena. This relates again to the fundamental ontological question mentioned above: 'what counts as political discourse?' More specifically, what forms does it take? There are at least two broad facets which influence the answer to these questions, both having undergone some process of expansion over recent decades. First of all, there is the extension of discourse analysis beyond the linguistic to other forms of the semiotic. Of special importance here is the pervasive influence of images in late-modern society (see Kress & Van Leeuwen, 2006 [1996]). If modernity is associated heavily with the development and dispersal of the written word via technologies such as the printing press, then this leads also to what is referred to in discourse analysis as the 'text', that is, "a contribution to communicative interaction which is designed for travel, so to speak – which is designed in one context with a view to its uptake in others" (Chouliaraki & Fairclough,

1999: 45). The late-modern text, moreover, is characterised not only by an intensification of such time-space distanciation, but also by a 'multisemiotic' constitution, frequently combining words with images, diagrams, audio, and other aesthetic qualities (ibid: 46). As such, following the 'linguistic turn', "[l]ate modernity has arguably involved an 'iconic turn', a shift in the economy of semiotic systems which has led to a questioning of the pre-eminence of language that has been generally taken for granted" (ibid: 50; Kress & van Leeuwen, 2006).

Across the fields of political geography and critical geopolitics, the focus within this iconic turn has been on the role of mapping in the (re)production of uneven relations of power (e.g. Ó Tuathail & Agnew, 1992; Wood, 1992). Far from a straightforward reflection of reality, the map constitutes, divides, and orders space. Along with other linguistic and semiotic formations, maps work to make space legible and actionable. Thus, "geopolitical reasoning works by the active suppression of the complex geographical reality of places in favour of controllable geopolitical abstractions" (Ó Tuathail & Agnew, 1992: 195). We can see immediately how this capacity might be especially relevant to the governance of the London Underground as both system and social space. As system, it demands the external monitoring and management of complexity; as social space, it demands also its internal navigation. Furthermore, as we will explain in more detail in the subsequent chapter, it was only with the abstract representation of the Underground space through Harry Beck's simplified Tube Map in the 1930s that it became both more easily navigable and more socially tolerable. Thus the everyday passenger experience of the Underground – and, moreover, of London as a whole – is always already filtered through the discursive frame of this diagram (Vertesi, 2008) in a way that informs our material actions towards that space.

The nature of the map – especially the map-as-diagram – is thus simultaneously discursive and functional. Through its selective arrangement of semiotic materials, it produces not only messages but also material affordances; particular ways of acting with (and especially navigating) the system it represents (*on 'affordances' see* Urry, 2007: 49; Michael, 2016). This brings us nicely to the second ontological debate: the question of the relations of discourse to practice. Accompanying the movement of discourse beyond language to include other semiotic forms, there is the movement which questions the firm boundaries between the semiotic and the physical; between signs and actions. As Müller points out, there are already suggestions in the work of Foucault that discourse and practice are densely intertwined, thus "pav[ing] the ground for abandoning the concept of the sign in favour of the concept of discursive practices" (2008: 329). Laclau and Mouffe (1985) take this further, rejecting the discursive/non-discursive distinction altogether, and instead positing a discursive totality of which practice is a part.

Chouliaraki and Fairclough (1999: 126) set out their CDA perspective as a negotiation of Laclau and Mouffe's position, similarly arguing that discourse and practice should not be viewed separately, but refusing to reduce social life (including practice) *to discourse*. Rather than giving discourse absolute primacy, they follow Harvey (1996) in conceptualising discourse and practice as different moments of a broader social totality. These moments interrelate dialectically via 'translations' to produce and reproduce the social (ibid: 6). In their words, "[t]here are complex equivalences and movements between language, other semiotic systems, and non-semiotic moments of social practices" (1999: 51). Applying this dialectical perspective to the field of International Relations, Milliken (1999: 240-1) argues that most approaches to discourse analysis, whilst devoting considerable attention to the discursive *formulation* of policies, do not sufficiently examine their *operationalisation* as practice. Using Foucault's (1977) work on criminality as an example, she points out that "the

meaning of categories for 'the criminal' and 'the delinquent' also had to be operationalized through measures organizing space in prisons and practices of surveillance developed to regulate the lives of prison inmates" (Milliken, 1999: 241). In other words, discourse should be studied not only as representation but also as something which does work and has material forms. With regards to spatiality in particular, the 'regime of truth' constituted by a certain hegemonic discourse is operationalised through particular spatial formations which afford given forms of behaviour whilst excluding or constraining others. It may work to move, to arrest, to separate, connect, or even emulsify given spaces, and, working ideologically, it may do so such that the organisation of space now witnessed appears as self-evident, natural, or common sense.

The dialectical relations of discourse and practice can be evidenced by thinking about the economic transformations characteristic of the late-capitalist mode of production and its aforementioned 'logistical fix'. Among the material changes we might count 'just-in-time' methods of production, the extension of supply chains enabled by innovations in transportation and containerisation and secured using new practices of surveillance, and novel employment practices based on flexible working hours and 'zero-hours' contracts. On the discursive side, Boltanski and Chiapello (2007) study in depth the 'neo-management discourse' through which the structure of the firm and the means of control were altered to suit (and to constitute) an increasingly globalised economy. From their analysis of 1990s management literature, they identify an emergent model for the corporate landscape, an ideal comprised of:

> "*lean* firms working as *networks* with a multitude of participants, organizing work in the form of teams or *projects*, intent on customer satisfaction, and a general mobilization of workers thanks to their leaders' *vision*" (2007: 73)

This involves an obsession with 'flexibility' in the aspiration towards an organization "that will be able to 'ride' all 'waves', adapt to all the changes, always have a workforce that is up to date with the most recent knowledge, and secure a permanent technological advantage over competitors" (ibid: 71). In relation to the problem of an uncertain world, the promotion of 'flexibility' becomes a vital 'symbolic resource' for ensuring both competitiveness and survival (Bourdieu, 1998. *Cited in* Chouliaraki & Fairclough, 1999: 4).

So, we might say that there is a discursive aspect to the material shifts of late capitalism that aims to envisage the firm as an increasingly resilient organisation. But the dialectical perspective asks that we do not stop here; instead, we should recognise that discourse not only 'backs up', 'legitimises', or 'reinforces' material changes, but rather helps to mutually constitute them. As Chouliaraki and Fairclough put it:

> "flexible accumulation' as a new economic form has been 'talked into being' in the substantial literature on the new capitalism – including the works of management 'gurus' which fill the shelves of airport and railway bookshelves internationally – as well as being put into practice through practical changes in organisations" (Chouliaraki & Fairclough, 1999: 4)

As such, the reality of 'flexibility' oscillates between discourse and practice, and we must refuse to neglect either moment. Though the discourse of flexibility is an idealistic one, and as such is not likely to be simply mirrored in how things *really* take shape on the ground, it is nonetheless not a mere fantasy. Or rather, we might say, just because it *is* a fantasy does not mean it is devoid of real, material impact. This relation is something we will return to in the context of the discursive regime of logistics and the LU, an environment within which discourse and practice are especially closely intertwined. For now, we turn to another feature of late modern discourse which is of special import to our discussions of circulation

and logistics: the hybrid text. This will be explained in relation to discursive analyses of 'smart urbanism'.

4.4. Hybrid Space, Hybrid Texts: the Discourses of 'Smart'

As mentioned, late-capitalist methods of just-in-time production are heavily reliant upon software which enables the real-time monitoring, adjustment, optimisation and recovery of value. This relation is constituted in part through a specific coalition of discourses. In their work on code and 'code/space' for instance, Kitchin and Dodge (2011: 19) suggest that "software and digital technologies are underpinned by their own particular, distinctive discursive regime". The concept of a discursive regime, taken from Foucault (1977), suggests not one discourse but "a set of interlocking discourses that sustain and reproduce, through processes of definition and exclusion, intelligibility and legitimacy, a particular set of sociospatial conditions" (2011: 18-19). The discursive regime of software consists, therefore, of an "amalgam of a number of common discourses: safety, security, efficiency, antifraud, empowerment, productivity, reliability, flexibility, economic rationality, and competitive advantage" (2011: 19). This assessment chimes with Chouliaraki and Fairclough's (1999) argument that one of the most distinctive features of late-modern discourse is its hybridity or 'intertextuality' (Kristeva, 1986). According to this understanding, singular texts have a tendency to articulate multiple 'genres', placing into complex relation a range of different vocabularies and styles (1999: 52-9). The way in which such combinations are articulated across a corpus of texts is not random; it likely has an "underlying pattern":

> "there is a social structuring of semiotic diversity, such that…discourses are related (separated, connected) in ways that have acquired a certain permanence. We shall call this social structuring of semiotic diversity the 'order of discourse" (ibid.: 57-8).

The hybridity of discourse therefore establishes an order which, in that process of ordering, prioritises and deprioritises, includes and excludes, makes intelligible and unintelligible. Such processes are ideological inasmuch as they represent the orderings and associations which they construct as pre-established or common sense. For example, discourses promoting software "are often promoted by government in tandem with business, driven by the interests of capitalism and, increasingly, the agenda of neoliberalism focused on the delivery of social services for profit within a target-driven culture" (Kitchin & Dodge, 2011: 19). These interests are buried within the hybridity of discourse, within connections established between terms, such as 'efficiency', 'flexibility' and 'freedom', that are taken to be unquestionably benign. The hegemony of a particular agenda can therefore be drawn out by detecting its style, terminology, or manner of speaking within other texts. The aforementioned late-capitalist infatuation with flexibility is a good example here since, further to Chiapello and Boltanski's analysis of that discourse within what might be thought of as its natural habitat, this is a discourse which increasingly percolates into other spheres. Chouliaraki and Fairclough thus mention "the normalising imposition of a configuration of neo-liberal economic and managerial discourses on a wide range of public and private organisations, schools, universities, hospitals, as well as commercial companies" (1999: 133). Rather than necessarily thinking of this in terms of discursive closure or domination, Chouliaraki and Fairclough suggest we mobilise Gramsci's (1971) notion of hegemony, as well as the Althusserian idea of 'interpellation'. According to this perspective, discourses work by inviting audiences to take up, and respond from the position of, given subjectivities, and to assess successes and failures; good and bad, according to given criteria. Achieving hegemony for a certain discourse means that things are translated into and evaluated through its measures. Given the importance of semiotic diversity, translation into a 'common language' often refers just as much to particular modes of visual representation;

translations-as-renderings. In a security context for example, Hagmann and Cavelty (2012) have argued that the national risk register allows for the comparison and ranking of potential threats by placing them onto the same visual calculative plain, as points on a graph of 'likelihood x impact', thus justifying a certain distribution of resources whilst at the same time concealing the various debates, differences in opinion, and decisions which have constituted this ordering.

Additionally, within a particular discursive regime certain (hegemonic) genres may convey (il)legitimacy to others through their interrelation. Following Wekerle and Jackson (2005: 35), we can refer to this function as 'hitchhiking': the process by which "a critical issue…is linked through language or policies to other issues that may be tenuously or not previously linked". The effect is to confer the concern and urgency with which a critical issue – that is, an issue successfully declared as 'critical' – is treated upon the other issues being linked to it. One of the most common occurrences of this function is witnessed in the discursive and material linkages made between migration and crime (including terrorism) across what Didier Bigo (1994) calls the 'security continuum'. Through processes at both "the level of signification" and that of "institutional practice", the categories of 'migrant' and 'criminal' are spoken and treated together, thus inflicting a 'transfer of illegitimacy' from the latter to the former (Bigo, 1994: 164; Walters, 2004: 240). In the aforementioned context of public sector marketisation, hitchhiking may be witnessed in the appeals made towards ideals of cost-efficiency, flexibility and competitiveness (as opposed to, say, quality of services or social equality) as a means of rationalising and legitimising policy choices. Public sector choices gain traction and acceptance through recourse to such devices, but are shaped by their logics and interests as a result.

More specifically, a hybrid text might suggest the formation of what Basu (2019), in her work on India's 'Smart Cities Mission', refers to as 'elite discourse coalitions'. Discourses may be produced in different spheres and hold contradictory priorities, but, through the process of coalition, "differences are ironed out for a simplified storyline" (ibid: 78). The production of a smooth storyline is thus an ideological process which covers over holes in the plot in an attempt to create a persuasive narrative in line with a shared set of interests. Similarly, Söderström, Paasche, and Klauser (2014) take IBM's global smarter city campaign as "a specific form of storytelling in the world of planning", arguing that the corporation's growing influence on urban governance since the turn of the century has been exercised in part by "the translation of the city into a unitary language and its inscription into a transformative narrative" (ibid: 307; 312). Specifically, they contend that IBM's discursive hegemony consists in the problematization of a given city as "a 'sick city' permeated by a series of pathologies" (ibid: 315). The problems identified in turn lend themselves to a given set of solutions which, somewhat predictably, are products or services offered by IBM themselves. The pivotal moment in the story is the creation of what they, following Callon (1986), refer to as 'obligatory passage points' (OPPs), that is, the discursive identification of certain procedures through which any successful transformation must inevitably (naturally, unquestionably) flow. In IBM's case, the problem is identified as the entrapment or isolation of data:

> "Data, it is argued, are trapped, 'unsmartly' organized in information silos, lost and not available when needed. They are under-used and their potential should therefore be unleashed" (Söderström et al., 2014: 315)

From this framing, IBM's software packages can be constructed as an OPP. As Söderström et al. put it, "technological solutions are presented as the *pharmakon* of contemporary urban pathologies through images and short stories" (ibid: 315). Software, we might add, has an

innate tendency to present as an OPP, having always described itself as a set of fixes designed to solve problems with various kinds of hardware; as '*software solutions*'.

If we compare the discursive regime of software and 'smart urbanism' to the above-mentioned discourses of resilience, we see again that there are notable similarities but also important differences. In particular, both seek to discursively reframe friction as part of the 'normal' nature of urban existence. However, whilst the latter tends to emphasise such events as possibilities for learning – learning, specifically, how to 'fail better' – the former concentrates on these problems as opportunities for introducing responsive, adaptable 'solutions'. Moreover, where the smart city is concerned, these opportunities are commercial opportunities; learning comes in the form of various purchasable products.

There are undoubtedly aspects of both the discourse of resilience and that of 'smart' technologies, which are also present in the governance of the Underground. However I want to distinguish a number of features which separate out what might be called a discursive regime of logistics, as that which aims to optimise and secure circulations based on an underlying logic of productivity and survivalism, and a complex interplay of physical and semiotic/symbolic mobilities. Furthermore, I will argue that, as a result of this latter point especially, even a critical discursive approach is insufficient, and that what is needed, therefore, is a methodological framework tailored to logistical power's distinctive governance of risk and value.

4.5. 'Move or Die': The Discursive Regime of Logistics

Deborah Cowen likens the discourse of the logistics industry to that of a particular genre of nature documentary: those grand and tension-filled depictions of global migratory flows underpinned by the motto "move or die" (2014: 197-200). More than an invented likeness, Cowen points out that one documentary making explicit use of that motto, the National

Geographic series *Great Migrations*, was sponsored by the United Parcel Service (UPS). Quoting the vice president of media sales for National Geographic Rich Goldfarb, Cowen relays how the partnership worked "to create an association between animal migratory behavior and the logistics that allow UPS to unfailingly ship millions of packages around the globe" (Crupi, 2010. *Quoted in* Cowen, 2014: 198). In short, if disruption is a threat to the gazelle, the antelope – a matter of survival – it must be a threat to us as well.

If the formative processes of contemporary logistics can be traced *both* to its military origins, *and* to its more recent role in the capitalist mode of production, then it should not be surprising that the discourse of logistics is one which mixes themes of violence, survivalism, and productivity. 'Move or die' refers at one and the same time to animal, biological death, and to socio-economic 'death'; corporate death; reputational death (the media crucifixion); branch closures and bankruptcy. This brings a specifically material emphasis to the discourses of flexibility and resilience, denoting not merely a general state of mind or 'spirit' but the necessity to maintain circulation through a malleability of movement. If one route of supply is suddenly disrupted or closed off, another must be quickly located. The discursive – linguistic and semiotic – moment of flexibility is thus in dialectical relation with design and spatial practices such as redundancy and re-routing, in addition to a plethora of real-time monitoring and calculative technologies.

We might talk, then, about a 'discursive regime of logistics', which would be a sub-discourse of both the regimes of resilience and 'smart' technologies. The discourse of logistics might be conceived initially as the version of these related discourses transposed onto mobility or circulation. When we talk about 'flexibility' and 'efficiency' therefore, we are talking fundamentally about the optimisation of material movements. In terms of appropriate conduct, to circulate efficiently is to take the most appropriate route; not necessarily to

move as fast as possible but to make the connection, to arrive on time. To circulate flexibly is to be capable of and prepared to respond to disruption, to take alternative routes. It is also, however, a discourse which frames the uncertainty and friction of circulation as *both* an inevitability to which we must learn to adapt, *and* as an opportunity upon which we must learn to capitalise. The discourse of logistics tends to frame all kinds mobilities as supply-chains, as circulations which produce or deliver value. As such, the aim is not only to avoid or cope with risks, but also to continually optimise, to boost efficiencies and increase productivity in a competitive context.

Furthermore however, I would like to claim that with logistical power we have something that exceeds discursive approaches, even those of the CDA variety. This has to do with a fundamental difference in how logistics expresses itself in comparison to either resilience or smart urbanism. The following conclusion takes up this point in more detail, arguing that the study of the LU necessitates a more nuanced methodological understanding of logistics, a form of power which can only be approached if we have an appreciation for its ability to coordinate material and semiotic elements, and to produce novel mechanisms that do not sit comfortably with the (albeit porous) categories of discourse and practice.

4.6. Beyond Discourse: Strategy in Pieces

As we said before, in resilience we seem to have an approach to the world which surrenders the pretence of control, seeking instead to prepare for and learn continually from the event-ual. On the other hand, in smart urbanism we have a way of thinking based on the recapture of control via rapid or 'real-time' modes of monitoring, anticipation and response. Reductively, these divergent attitudes might be aligned with the tactical and the strategic, lending themselves to methodological approaches which focus either on 'real', 'material', small-scale and bottom-up processes, or alternatively on totalising, top-down

plans and projects. As explained in chapters one and two however, the coexistence and intermingling of resilience-thinking and smart urbanism problematise any such binary, and logistical power is distinguished by its continual oscillation between strategic and tactical perspectives (Neilson, 2012). What, then, are the appropriate objects of analysis for such a framework?

To take one small but representative example, Harry Beck's famous rendering of the Tube Map is often analysed as a central tool in how the LU, and in fact the city more broadly, is discursively constructed in the minds of its users, and thereby how it is interacted with (*e.g.* Vertesi, 2008; Benoit & Laver, 2011). As was noted briefly earlier in this chapter, the Tube Map does not simply 'reflect' reality; instead, it 'distorts' it, simplifying its complexity. The Tube Map is then an especially effective kind of *strategic abstraction*, allowing the viewer to quickly obtain an overview of, to comprehend, and to plan their route through what is in actual fact a large, complex, and varied set of spaces. Far less attention has been paid, however, to the ways in which this *strategic abstraction* is broken down, fragmented and dispersed. Although the image of the network as a static whole remains a powerful symbol and tool of planning, it is just as often encountered in a piecemeal fashion, scattered throughout the interior of the network itself – painted or pasted onto walls, or the interior of carriages – or downloaded to a mobile device through which it is zoomed and searched according to the needs of the current situation. Particularly as mobile, 'smart' and 'real-time' technologies become increasingly common ways of monitoring and interacting with infrastructure and urban space, maps and plans can hardly be restricted to a singular, static, and stable state. Constituted through feedback loops, they exist neither wholly inside nor outside the space to which they are addressed. The move from a critical discursive to a more fully critical study of logistics must therefore include consideration of such fragmented, circulating, and situational elements.

Furthermore, the attention of a logistical framework to positive as well as negative possibilities beckons consideration of the ways in which such forms of representation and conduct might play a role in the maximisation of value. This is an idea which will be picked up again in chapter six, but for now we need to identify a second, related way in which a critical approach to logistics should, I feel, differ from existing critical discursive approaches. This is based upon a complication of the categories of discourse and practice.

At first, it appears that the conceptualisation of practice as being in dialectical relation with the discursive moment is an appropriate way of approaching the present piece of research, since what we have with logistics is a rationality whose power is expressed simultaneously in discourse (language, images, and other signs) and in the spatial and institutional arrangements which it encourages, enables, and makes sense of. In the case of the LU, the specific dialectic is expressed most obviously as the relation between discourse, knowability and navigation. The Underground, as Krajina (2013: 231) puts it, is 'directional space', dominated by the imperative of continual circulation. In this context, discourse and practice are particularly closely bound – whatever the environment conveys to passengers in terms of semiotic content, this must be orientated towards the ideal of bodies in perpetual motion. However, it is debatable whether the mechanisms involved here can be captured by the dialectic of discourse and practice. When Virilio (2005b) describes the Paris Métropolitain as 'signal saturation', he evokes something more than an abundance of signs or instructions. Rather, it suggests a composite of semiosis and matter, as if the atmosphere in such spaces is heavy and sodden with messages. Is it not the case then that systems of navigation – in the fragmentary and mobile manifestations mentioned above – in fact involve unique forms which sit in an ambiguous zone *between* discourse and practice? As I already touched upon in chapter two, do they not indicate an affective, perhaps even 'presubjective' (Massumi) mode of communication, revealing the inadequacy of discourse-based

conceptualisations such as interpellation? This interesting category of directional semiotics will be revisited in later chapters.

The unrivalled degree of immediacy between the material and the semiotic also prompts a rethinking of the critical discursive notions of genre and hybridity. We might initially say, for example, that the functionality of the Underground depends upon the seamless co-articulation of multiple genres, various amalgamations of (to name only the most obvious): navigation, efficiency, safety, security, advertising, and art. As a result of such processes of co-articulation, we get a certain textual hybridity. For instance, from the mutual constitution of the advertising and navigational genres we get a unique (but increasingly common) sub-category: the mobile advert, or the art of 'out of home' advertising. As will be discussed in subsequent chapters, this genre is increasingly important to the TfL as a source of commercial revenue. This is where the discursive notion of genre falls short, however. For a crucial feature of such a form lies in the centrality of the relations between mobility, space, matter, aesthetics, and affect. These are the kinds of more specific mechanisms which the simplicity of Virilio's 'signal saturation' belies.

The circulatory imperative of the space demands that the arrangements of its functions be extremely carefully thought out, but this is not only a matter of *contradictions between genres*. Rather, it is an explicitly spatial, material, and sensory set of concerns which express the danger of collisions and stoppages. Thus, elements might be arranged such that the greatest possible benefits can be derived from, for instance, advertising, without, however, its presence *obstructing* or leading to the breakdown of the semiotic systems of navigation, safety, or security. This is, then, the purpose of logistical ordering: to tightly and elegantly knit together, to rank and balance, a selection of competing priorities and to extract the greatest possible value from the sum of circulations conceived not merely as a given set of

discursive practices, but explicitly as a material and sensory space. This set of objectives, is, of course, a well-suited climate for the application of real-time technologies of communication and calculation because they purport to allow for the immediate and integrated calculation and adaptation of environments; of circulations and their interactions. The promise of such technologies is thus *to maximise the value extracted from circulation without risking collisions of a semiotic or material kind*. They thereby function through the dynamic rearrangement of words, images, sensory stimuli, and bodies on the move.

How do we go about examining these orders or regimes? The rationale for my methods lies in the need to investigate both the nature of the managerial or 'elite' discourses and practices surrounding the governance of circulation on the Underground, and the semiotic, material, sensory and affective mechanisms as they are both planned and experienced through daily use of the space. Both sides of the coin are informed by the critical approach to logistics described above. However, whereas the former is based primarily on an analysis of documents and interviews, the latter additionally draws upon studies of architecture, design and mobilities in order to examine how logistics structures everyday spaces and experiences. In short, we move from an approach that seeks to order circulations strategically, to one which, although retaining a managerial perspective, looks to shape circulations iteratively, from within their midst. The following methods section gives brief justifications for each of these approaches and the ways in which they will be applied to the empirical research objectives below.

4.7. Empirical Objectives & Methods

In light of the issues raised in chapters one and two, together with the particularities of the LU as a case study, my objectives for the empirical sections of this thesis can be introduced as the aim to:

1) Ask whether, and if so how, the types of events affecting the Underground system exceed traditional (archival-statistical) risk calculations.
    a. Compare these events with those affecting other urban spaces and systems.

2) Following Collier & Lakoff's schema of VSS, elucidate the moment of initial articulation, aim(s), object, form(s) of knowledge, and characteristic apparatuses mobilised by relevant agencies in order to govern or manage events on the Underground.
    a. Ascertain whether and, if so, how and why this way of governing has changed since the initial articulation of VSS in the post-WWII/Cold War era.
    b. Compare these mechanisms to those applied to other urban infrastructures.

3) Question how this way of governing compares to the other key frameworks analysed in the literature review: resilience-thinking, VSS, and smart urbanism.
    a. Ask whether any of these frameworks are sufficient to account for the ideas discussed in relation to objectives 1) and 2), and, if not, what kind of alternative framework might be developed.

In attempting to respond to these tasks, I deploy the following methods.

The Dominant Discourse: Document Analysis & Elite Interviews

> "Since discourses are social systems of signification, it will not do…to base a discursive analysis only on one text, even some 'key' document…Instead…a discourse analysis should be based upon a set of texts by different people presumed (according to the research focus) to be authorized speakers/writers of a dominant discourse or to think and act within alternative discourses"
>
> (Milliken, 1999: 233)

Despite my methodological critique of discursive approaches in the context of logistics, the document analysis which I carry out in what follows is loyal to Milliken's recommendations in examining a large set of documents produced by a range of agencies responsible for writing about the governance of the UK's and London's infrastructure, its transportation systems, and in particular the London Underground. The documents examined fall into two rough categories. The first focuses on policy, guidance, and strategic documents produced by UK Government departments (prominently the Cabinet Office and, given my case study, the Department for Transport), national and regional police forces (including the British Transport Police (BTP)), and a number of London-specific groups, such as Transport for London (TfL), the Greater London Authority (GLA), and London Resilience. The intention of this grouping was to elucidate the general framework of emergency governance, and its implementation with regards to urban public transportation infrastructure (in comparison to other infrastructure sectors). The second category brings in documentation related to the private sector, specifically that which outlines ideas and proposes calculative technologies for enhancing the response to disruptive incidents within urban public transport systems. This is not to imply a clear separation between public and private initiatives, with a key claim being that these areas are often drawn into alignment or hybridity.

Moreover, my approach also pays attention to the notion that such texts do not exist in isolation, and thus that "a discourse analysis should compare these object spaces to uncover the relational distinctions that arguably order the ensemble, serving as a frame (most often hierarchical) for defining certain subject identities" (ibid.). This relational approach is particularly useful given that many of the written texts being analysed appear at first as dry and seemingly apolitical and unopinionated policy papers, reports, and guidance documents. It is only by looking at the linkages across and between them that we are able to begin to draw out what van Dijk (1995: 38) describes as the 'something fishy'.

Like Milliken's approach, mine also intends to elucidate relational distinctions that order the discursive ensemble. The focus on subject identities is not exclusive and not always direct, but by talking, as we will, of given articulations of subjectivity; certain forms of conduct, we will be talking about a prioritisation of one form of subjectivity to the marginalisation of potential others. It should be kept in mind however, that the second half of my method will look to move past this focus.

The document analysis is supplemented by a set of ten elite, semi-structured interviews carried out during the period May-September 2018 with a number of individuals highly experienced in areas of disruption management, major incident response, resilience, transport policing and emergency communications. All interviewees had direct experience working – either currently, or in the past – for one or more of the institutions central to the governance of the Underground and UK transportation infrastructure. My network of interviewees was established primarily through one former BTP officer, and as such eight of the ten interviewees had worked with the BTP at some point during their careers. The majority of these individuals had worked at various levels of the BTP, including front-line roles as well as positions of strategic command, and many had moved onto related roles in resilience and security with organisations including TfL, the Civil Aviation Authority, and in the private sector (including for suppliers of emergency communications). Independently of this network, one of the interviews was carried out with an individual from the Cabinet Office. The intent of these interviews was twofold: first, to draw comparisons between the theoretical literature, the document analysis, and the application of emergency response in practice, noting where these sources aligned and diverged. For example, information was sought on whether, and if so why and how, resilience and rapid response were being prioritised, and the potential role of technologies in mediating these approaches. Second, there was the objective to identify the underlying rationales animating response in the

specific context of London's transportation systems, in particular the LU. This included ways of thinking about risk, together with conceptions of the railway and Underground environments. A semi-structured interview technique (as opposed to structured techniques, surveys, or free discussion) was chosen for the reason that this enabled me to direct the subject matter of the discussion towards those areas relevant to my research questions, whilst at the same time allowing for a considerable degree of flexibility through which interviewees could describe, in their own words, the ways in which they perceived the task of governance. In this way, I could (attempt to) find out what I wanted to know, but I could also be told of things (ways of thinking and doing) I had not previously been aware of. Each set of questions followed a similar framework, covering those issues with which I was primarily interested. For instance, every interview began with the request for the interviewee to describe the path of their career and the incidents which they felt had most profoundly shaped how the Underground and the transportation network is governed. Additionally, every interview included the question of what 'resilience' meant in the context of transportation and the Underground. However, beyond this general blueprint each interview was tailored to the interviewee, to their particular experience and expertise.

Whilst the study of documentation and interviews offers the view from above – the classic strategic or 'god's-eye' view – it is integral to logistics that it works simultaneously from above and from below; that it disperses whilst integrating. As such, my second set of methods intends to look at how logistics (inclusive of but also beyond discourse) is operationalised within the Underground itself, as a wide range of mechanisms aiming at the optimisation of circulation – including discursive, semiotic, but also other spatial, aesthetic and affective technics.

Directional Semiotics: Logistics from Within

If De Certeau's (1984) binary of the strategic and the tactical continues to inspire many of the critical research approaches of 'mobile methodologies' (e.g. Jensen, 2009), then the problematisation of De Certeau's conceptualisation wrought by logistics must also make us readjust how we go about studying the world as a space of (im)mobilities. As journeys become increasingly crucial for the extraction of value and as a potential realm of control, more detailed critical attention needs to be paid to the minutae of *how* we move; what rail companies would call the 'passenger experience'. One clue here might come from Virilio's aforementioned (2005a) work on the notion of 'dromoscopy', which focuses both on circulation as such, and on how circulation is experienced by the human body. More will be said on this set of ideas in subsequent chapters, but for now it works to foreground a need for methodologies to take into account the embodied and multi-sensory experiences of mobility (*see* Pink, 2009).

The suggestions of my literature review and methodology chapters are that logistics addresses circulations not only through processes of subjectification and interpellation in a discursive or ideological sense. It also works through much more material, spatial, aesthetic and affective techniques. As such, my methods turn to a particular focus on the architecture and design of the Underground. In practice, this means studying both a range of design documents, and by analysing materials – from images, to posters, advertisements, signs, and so on – that are recorded or 'found' within the space of the network itself.

A few more specific concerns arise in relation to these methods. First of all, there is the practical difficulty of researching a logistical space 'from within'. To put it simply, the directional imperatives and often crowded nature of the environment mean that to pause, and to reflect upon what one is experiencing, is difficult not only physically, but also because hesitation is viewed as a risk with potentially serious consequences. This is especially evident

in the case of photography. Formally, there are rules which restrict photography and filming on the Underground. TfL regulations permit photography only if it is whilst 'passing through' the network. For any other form, there is a fee of £600/hour (TfL, n.d. [b]). Moreover, taking photos of the Underground system – and of infrastructure more generally – is inextricably linked to understandings of 'suspicious behaviour', especially in a terrorism context (Fig. 7). 'Normal' behaviour in such environments is narrowly restricted to certain kinds of bodily activity and attention. One is expected either to be moving, or to be 'waiting' to move, an orientation itself indicated by a number of identifiable gestures. As one article explaining the role of 'predictive profiling' and terrorism 'spotters' in Amsterdam Central station puts it, "[a]nyone who was waiting for a train would normally be expected to look at departure boards" (BBC, 2018; *see* Salter, 2007). Not participating in or being orientated towards circulation can, in such spaces, be enough to be viewed as a potentially risky subject, an insider threat.

Figure 7: Photography as suspicious behaviour

Secondly, once images are sourced, there is the question of how they are to be used. Numerous studies 'use' photos or images in their research, without declaring them as a part of the research method. What is the distinction then, between images *in* research and images *as* research? Here, we can take a lesson from visual anthropology and sociology. In his overview of these disciplines, Douglas Harper cites from George and Louise Spindler's foreword to Collier's (1967) *Visual Anthropology* the astute observation that "usually an

anthropologist takes a photograph to illustrate a finding that he [sic] has already decided is significant…He waits until whatever it is happens, then points his camera at it…He uses the camera not as a research technique, but as a highly selective confirmation that certain things are so, or as a very selective sample of 'reality'" (1967: x. *Quoted in* Harper, 1998: 27). In other words, photographs, if they are to be regarded as a research technique, should be implicated within the process of discovery and understanding that is the research project, rather than as a *post-facto* method of illustration working on behalf of the text.

A further consideration lies in the depth of analysis impressed upon the image or photograph. When images are utilised as mere illustrations, their aim is to function as 'visual hooks': striking eye-catchers which, as in textbooks or newspapers, ease the weight of uninterrupted text, provide a splash of colour, and allow for the rapid absorption of a simplistic level of information (Banks & Zeitlyn, 2015: 19). Images deployed *as* research, in contrast, should beg to be reflected upon. This is especially important given my project's critical attention to the abstraction, diagramming, or interfacing of subterranean mobilities. In order that the images and surfaces I am critiquing do not merely reinforce the fetishization of logistical landscapes (*see* ch.6), attention needs to be paid especially to both the production of an image and to the ways in which it is received and interacted with. In practice, this meant that the photographs featured within this thesis were taken for one of two reasons. First, they were intentionally sought to illustrate the reflection of, or divergence from, those principles outlined in interviews or the documentation. Secondly, they were taken in a much more impromptu fashion to visually note or record aspects of the Underground environment which occurred to me as intriguing, functionally (ie. in terms of what they were trying to achieve) and/or aesthetically (ie. how they looked or felt), or furthermore as unique – differentiated from the sorts of forms and sights witnessed in spaces outside the transportation network and outside the London Underground. Crucially,

even if images were consciously sought, attempts were made to critically reflect upon these images in order to consider why I took a certain image, why I had, in the moment, elected to frame an image in a given way, and even why I had decided to take some images in colour and others in greyscale. In part, this serves to bring a sense of vulnerability to the research process; to open up my observations to the possibility that they may fall into the trappings of the very same logic which they are seeking to critique. It could well be noted, for instance, that the choice of black and white for many of the photos in this thesis – though at times this was intended to pick out differentials in light and shadow – submits to a certain aesthetic sensibility that might be labelled nostalgic, romantic, or simply 'trendy'. In the same vein, a number of these images are marked by a distinct absence of human bodies. On the one hand, this helped to clarify the subject of each image and bring attention to the spatial and the architectural. On the other, it could be criticised for severing the social from the spatial and obscuring the very social complexity central to such spaces.

These critical reflections, both of photographs taken and of other observations, were recorded in what I am calling a 'research diary', but what was in reality a collection of notes held on my phone and in various notepads. These accompanying notes included the time and date, as well as the location and route at/on which each observation was made. As well as observations of spatial properties, such as aspects of design, architecture, signage, and so on, observations of performances and interactions were also noted using the diary. These included events within the network, such as the interaction with the group of tourists featured in the introduction, as well as participant observation of the control room operators at Palestra House.

The use of these relatively personal, researcher-led methods inevitably raises a number of ethical issues and questions associated with positionality. Specifically, my position as a white,

male, able-bodied researcher impacts my perspective in such a way that I risk failing to notice the obstacles and risks encountered by other passengers. The use of the research diary to reflect critically upon my own experiences and observations represents an attempt to temper this risk. However it must be kept in mind throughout that this process will always be incomplete, meaning that a number of the claims made will be speculative and partial.

Finally, a method which aims to study a space in which continued circulation is the norm can take inspiration from approaches that emphasise non-logistical interpretations of urban space, but it must also be conscious of oversimplifying its position to a matter of tactics vs. strategy, or stillness vs. movement. For instance, we can take as a starting point the Situationist method of 'dérive' – Guy Debord's (1956) aimless; map-less 'drift' as a means of experiencing the city as something other than spectacle, something other than the "scrim of commodities and power" (Marcus, 1989: 164. *Quoted in* Thatcher & Dalton, 2017: 141). More specifically, we might pick up on the notion of the 'static-dérive'. As Debord noted, the method of drifting does not necessitate extensive or continuous movement; "it can be limited to a small self-contained ambiance: a single neighbourhood or even a single block of houses…the extreme case being a static-dérive of an entire day within the Saint-Lazare train station…" (Debord, 1956: n.p.). Like a piece of debris bobbing up and down in the sea as the waves sweep under it, a dérive can involve a kind of conscious holding of position against the multiple cues and urges to keep moving. However, such an attitude must be supplemented by a critical attention to those cues themselves, and more broadly to those logistical processes and feedback loops which ceaselessly translate between tactics and strategy.

Thatcher and Dalton (2017) for example have recently proposed the 'data dérive' as a form of praxis designed to interrogate what they call the 'data spectacle'. The data dérive as they see it involves "combining exploration of environments with an investigation of the radical alternative possibilities hidden within the contexts of our daily (digital) lives. The key theoretical move…is a recognition of the separation between the depth and nuance of an individual's lived experience and the data produced by those experiences" (2017: 143). Their combined examination of code and space is informative, but what is fundamental to such an approach in the context of logistical power is not the study of data per se but a wider range of mechanisms which oscillate between lived experiences and their renderings as vital systems, networks, or supply-chains. My approach thus consists of an effort to situate both digital and other forms of interface, and to think through their roles in the constitution and (re-)ordering of the Underground space, together with the movements and (sensory, affective) experiences of the body in circulation.

The results of my investigation will be presented over the course of the next two chapters.

Introduction to the Empirics

The subsequent two chapters are intended to examine the themes and questions identified in the literature review through a detailed study of the governance of the London Underground. The first chapter takes as its main focus an analysis of documents, together with interviews, which represent the main logics and patterns of governance – from the conception of risk to forms of knowledge for resilience and response, including those emerging out of logistics – and the second chapter, probing beyond the abstract notions of 'network' or 'system', explores the material, sensory and affective mechanisms which seek to govern the Underground iteratively and from within.

5. Dynamic Risk, Rapid Response, and Logistical Power in the Governance of the London Underground

5.1. Introduction

The following chapter uses a two-pronged method of qualitative document analysis and elite, semi-structured interview to empirically investigate the ideas presented so far, and to further develop theoretical arguments in the context of a particular case study: London's public transport infrastructure, centrally the Underground network.

In answer to the three core objectives outlined at the end of the previous chapter, it will be argued, firstly, that the types of events affecting the Underground system do exceed traditional (archival-statistical) risk calculations. They do so not primarily because of the possibility for unprecedented events, but because regular and familiar phenomena have the potential to expand and spread rapidly, interacting with other flows and elements of the environment to produce unpredictable effects. This problem is one of *dynamic risk*. Dynamic risk is distinct from 'late-modern' risk in that its emergence is a result not of technical complexity, but more specifically a combination of social and spatial complexity. In order to underline the historicity of this relation, the aforementioned theory of levée effects is extended back beyond the late-modern to contend that the first levée was the (Under)ground itself; the decision to dig out, below the populated surface of the city, a space of uninterrupted circulation. A set of primary levée effects therefore arise as a consequence not of technical complexity itself, but of the attempt to circumvent the frictions and socio-political intricacies of the urban space. These are expressed in the material and socio-spatial characteristics of the environment. The Underground is dense but circulatory, connected but isolated, crowded but transient, a familiar network but an unknown geography, and it is these factors which make it especially vulnerable to a range of hazards. What I will call the 'secondary levée effects' of the Underground therefore derive

from attempts to respond to this initial set of problems. Most prominently, the result of any stoppage is widespread disruption, and with this comes a further set of potentially severe consequences, not only for the safety of passengers on the Underground itself, but for the economic and political reputations of London and the UK.

Secondly therefore, it will be claimed that the aims, forms of knowledge, and apparatuses mobilised to govern dynamic risk are characterised by the need to balance rapid response with strategic (system-orientated, multi-agency) decision-making. This produces attempts to increase the pace of multi-agency response, and at the same time to allow access to mobile tools of 'situational awareness' to assess and re-assess events as they unfold. Rather than prioritising one over the other, the tension between these two aims is hoped to be resolved via a 'scalable' approach, allowing for rapid transition between tactical and strategic levels of command and perspective.

The scalable approach is distinguished from the 'system-vulnerability thinking' and 'enactment' of VSS through its attempts to integrate the governance of potential emergencies more fully into everyday operations, utilising 'real-time' forms and technologies of monitoring, communication and calculation to enable flexible and creative responses. The chapter here picks up on a point raised across my interviews, that large-scale multi-agency exercising was, especially in the context of public sector funding cuts, being deprioritised. The appeal of the alternative, scalable approach is as such based not only on the claim of enhanced response capabilities, but also the argument that costs can be cut and revenues boosted through the implementation of joined-up, data-led techniques. These arguments are pushed with the most enthusiasm by the logistics and security firms that supply the technologies in question. While this may initially be seen as an example of the corporatisation of urban governance through programmes of 'smart urbanism', I come to

argue that the core rationale of such projects is distinctly logistical. Rather than a straightforward drive for control and profit, these firms, as logistics firms, tend to express a duality of aim. They market themselves in particular through the promise, on the one hand, to build the resilience of the Underground in the face of radical uncertainty, and, on the other, to provide new opportunities for enhancing operational efficiencies, increasing capacity, and generating revenue in the context of financial scarcity. They market themselves, in other words, on the promise of *doing more with less*.

The growing influence of logistics is evidenced through three cases wherein governance of the LU is being augmented through exploitation of data and 'smart' technologies. What is found to be significant about these cases is their unique combination of integration and dispersal, centralising control whilst also distributing responsibilities to the frontline and to passengers. The chapter concludes by considering what this unusual combination of centralisation and dispersal means for urban subjectivity and the political binary of the tactical and the strategic. I argue that a logistical lens necessitates substituting critique of strategic abstractions with consideration of *interface* as a logistical oscillation between the tactical and the strategic.

5.2. Conceptualising Risk on the London Underground

Initially, the chapter seeks to answer the question of how risk is conceived in relation to urban transport infrastructure and the London Underground. The underlying theoretical question here is whether such thinking belongs to traditional (archival-statistical) risk-based approaches, or whether it in some way exceeds them, and, if so, what form(s) of knowledge and characteristic apparatuses are mobilised in order to calculate and manage this excess. Developing upon the ideas of chapter one, it is suggested that transport systems, especially the Underground, produce *dynamic risks*: risks which, if left untreated, have a tendency to

expand rapidly and unpredictably, changing in nature and scale, with potentially catastrophic outcomes. As such, they undermine traditional archival-statistical forms of risk calculation based upon the possible reoccurrence of past events. Differentiated from the technical concept of 'cascading failure', the complexity of such dynamic risks is eminently socio-technical and spatial: it develops through the interaction of flows of people and the material flows of their environment.

Levée Effects of a Subterranean Network: The Risks of A to B

> "If you are going underground, why bother with geography? Connections are the thing"
>
> (Harry Beck. *Quoted in* Long, 2014: 58).

In chapter one Law's (2004) appropriation of the levée effect was used to think through the mobilities of late-modern risk: the ways in which regimes of safety and security aiming to regulate flows can end up intensifying the potential for sudden, potentially catastrophic episodes of disruption and contagion. In the context of the Underground, this concept is again useful, allowing us to understand both how that network functions as urban infrastructure (as a space of circulation), and the risks produced by this relation with the rest of the city.

The first thing to remember in all this is that the first 'levée' is the surface of the earth itself. Although that surface might be thought of as 'natural', it has in fact become a barrier; a levée, only through practices (often distinctly modern) of excavation and extraction which have hollowed out numerous 'artificial' spaces beneath it. Subterranean railways – alongside wells, mines, and bunkers – are one such space, and the LU represents not only the oldest but also one of the most complex examples of an urban metro system. What is the function of this levée? It is to secure circulation. More specifically, it is to secure the rapid and consistent circulation of people through the city, 'from A to B'. On the one hand, this

function is performed for the city, on its behalf; on the other, it is performed against or in spite of it. *For* the city because, as a composite of producers and consumers, the people it circulates create value for urban economies and institutions – both directly, by paying for the service itself (not to mention the goods and advertisements they consume on their journeys, something which will be discussed at a later point) and indirectly, via the working and consuming they do at their destinations. *Against* the city because the function of the Underground is not something which could be aspired to so readily in the city itself, only beneath it. The surface is a levée therefore because it is formed in the attempt to escape the risks which proliferate above ground – from traffic congestion and bad weather, to political and social frictions, and the built environment itself (*see* Fig. 8).

There are many advantages to this vertical arrangement. Thinking in the terms of urban circulatory governance laid out in the first chapter, it is an architecture which in principle enables flows to be monitored, calculated and secured much more easily. Circulations that were previously disparate and affected by the uncertainties of whim and external factors are now, at least in principle, regulated into a smaller number of scheduled and planned 'journeys'. The city can thus be viewed as a strategic system, while, from a more logistical perspective, journeys can be tied together at set points of interchange. In the competitive context of global city-hood, such calculability and efficiency – what Reid would call a pacification – in turn contributes to metrics of brand and reputation, an internationally-recognised metric of quality of life as the capacity to circulate in rapid and timely fashion (Reid, 2006; Cowen, 2014). However, the arrangement is also productive of some elemental levée effects: risks which emerge as a consequence of the attempts to secure circulation from the vagaries of the urban. These are multiple but closely interrelated, and stem from a common twin factor: that of material isolation or inaccessibility combined with a high

density of population and flow. The risks will be introduced here, but also returned to later in the chapter, where they will be explained in further detail.

First of all, being underground in an environment where, by its very nature, entrance and exit points are limited, there is the potential for *(over)crowding and entrapment*. This has implications related not only to the formation of risks but also to the severity of their potential effects. In particular, the material conditions of the environment mean that, if something does happen, response is a more complicated process than it would be elsewhere. As one interviewee, a public sector specialist in transport security and response, put it:

> "we believe that any attack on the Underground system is probably more devastating because of the fact that, if it happens underground, it's very very difficult for emergency services to get there to respond to it, and very very difficult to get people out of the way. So unfortunately our environment, should something happen, it's probably one of the worst environments…" (Interview 9)

Already, this presents the Underground as an environment in which the management of multiple circulations is pivotal. Secondly, the density of being in an enclosed, crowded system is not purely a physical matter; keeping in mind the social nature of such a system, it also has important *psychological implications*, notably playing on fears and anxieties such as claustrophobia. This can again make response a more difficult process to regulate, requiring particularly delicate procedures of communication and crowd management. In the rail environment, for instance, 'self-evacuation' is far more likely than on other transport modes:

> "You don't get people smashing windows on buses to get out in the middle of the highway. You do get that on trains if they've been stationary, 'out of course' (as in, at an unscheduled stop) for a relatively short period of time. The likelihood in some circumstances of people self-detraining now is less than 10 minutes." (Interview 3)

This kind of issue is exacerbated further in the specific Underground environment, especially in tunnel sections where the possibilities of escape are even more restricted, and the consequences more dangerous.

Closely linked to both of the above factors is a third: the fact that the Underground network is to a large extent an *unknown geography*. As the quote at the top of this section illustrates, Beck's iconic Tube map was devised specifically with the irrelevance of geography in mind, and the everyday passenger experience of the network is not so much geographical as semiotic and logistical – that is, it is characterised primarily by following signs, changing lines, and making connections. As such, there is very little publicly available information about the accurate dimensions of the network. For instance, in 2015 it took a freedom of information request by an internet blogger for TfL to release three-dimensional images of 124 London Underground stations, but still these were not to scale and the locations of certain areas were redacted (IanVisits, 2015). The potential result in an emergency is that passengers can become disorientated, making orderly response procedures yet more problematic. Moreover, this is a problem which has also afflicted the police and emergency services, hindering efforts to locate incidents and coordinate timely response.

Finally, and of vital importance for what follows, are the difficulties posed by the Underground with respect to communications. This issue has been highlighted in the aftermath of several major incidents on the network, including the King's Cross fire in 1987 and the bombings of July 7th 2005, and continues to attract considerable attention in the context of recent attempts to increase the speed and effectiveness of response by upgrading systems of signalling, radio communications, and digital data transmission. Of particular significance is the way in which recent developments have attempted both to integrate and

to disperse control, enrolling the passengers themselves into the governance of the network.

Introducing these factors as levée effects helps us to understand the difficulties of response in the Underground environment, but what it does not do is tell us why overcoming those difficulties is a critical task for urban governance. Why, in particular, is *rapid* response so important on the Underground? What happens if the response is not fast enough? Answering these questions first means positioning the risks specific to the LU relative to wider understandings of risk in the context of London's urban space. It is found that the Underground is a space which typifies the problems associated with two recent UK Government conceptualisations: 'crowded places' (Home Office, 2009; 2012) and 'Complex and Built Environments' (Cabinet Office – Emergency Planning College, 2007), and as such is characterised not only by the potential for sudden, catastrophic events, but also by more common, everyday events in which risk is *unstable* or *dynamic*, meaning they hold the potential to *become catastrophic*, developing in especially rapid and unpredictable ways. This creates a tension between the need to deal with events as they emerge, and the additional risks (what I will call 'secondary levée effects') produced in doing so.

The Dynamic Risks of Urban Space: 'Crowded Places', 'Complex' Environments and Transport Systems

> "Incidents are said to have 'structure' because they are produced by identifiable and assessable risks and present themselves in fairly predictable ways…Crises, on the other hand, are often produced by risks that had not been identified, or at least not identified with the scale and intensity they presented. [They] may also be the product of an unforeseen combination of interdependent risks. They develop in unpredictable ways, and the response usually requires genuinely creative, as opposed to pre-prepared, solutions"
>
> (Cabinet Office & British Standards Institute (BSI), 2011: 6)

Starting generally, we can say that London's public or semi-public spaces are afflicted by the potential for 'rapid-onset emergencies': sudden, unlikely but potentially catastrophic events which push at the limits of archival-statistical methods. However, this is not always a consequence of the mere fact that – as was the case for nuclear preparedness – such events have not happened before, but more accurately because, even if they have, their *behaviour or dynamics* are held to be uniquely uncertain. This unfolding is a spatial phenomenon in the fullest sense, in that it occurs not only *within* space but is produced *through* it; through the ways in which the built environment distributes, channels, separates, and gathers together urban flows. Evidence on this point is provided initially by two UK Government documents, both concerned with assessing the types of risk to which the UK's urban spaces are exposed: firstly, *Safer Places*, in fact a set of three papers produced by the Home Office (2004; 2009; 2012)[7], and, secondly, *Public Safety in Complex and Built Environments*, a piece of guidance produced by the Cabinet Office's Emergency Planning College (2007).

The original version of *Safer Places*, subtitled 'The Planning System and Crime Prevention', focuses primarily on crime as a risk to which urban residents may be exposed on a daily basis, and suggests ways in which the design of the urban environment can help or hinder in reducing this risk. The spatial locus of risk across this document is "ambiguous space", as opposed to "well-defined and purposeful space" (Home Office, 2004: 22), and as such two broad solutions are suggested: ideally, spaces are designed so as to make them 'legible', clearly defining access and purpose. In particular, the document urges communities to take 'ownership' of spaces in order to define behavioural norms (ibid.). If ambiguity cannot be removed in this way, privatisation is put forward as an option, "removing public space from the public realm, where there is a surfeit" (ibid: 22).

[7] In 2017, an updated version of the latter counter-terrorism guidance was published by the National Counter-Terrorism and Security Office (NaCTSO, 2017)

In contrast, the 2009 and 2012 documents concern themselves with a much more catastrophic kind of risk: the vulnerabilities of what they term the 'crowded place', defined as "a location or environment to which members of the public have access that may be considered potentially liable to terrorist attack by virtue of its crowd density." (Home Office, 2009: 3). This kind of space poses a different challenge to those of the 2004 document, not only because of the no-warning nature of the events to which it is vulnerable, but also because, in being a space of mass congregation, ambiguity is a fundamental characteristic, and assertions of ownership or community can be difficult to make with any certainty. It is thus first of all the *social complexity* of such spaces – their transience and density – which means that, regardless of the causes of events, their effects have a tendency to cascade or rapidly expand, making them difficult to control or contain. The catastrophic potential of the crowded place lies, secondly, in its *spatial complexity*, in particular the fact that, as Aradau and Van Munster (2012a: 103) have pointed out, it is "simultaneously open and closed"; while densely packed, it is at the same time heavily interconnected. Its density is constituted by the arrival and intersection, in close quarters, of multiple flows of bodies. Consequently, the crowded place is characterised by a form of risk that itself has a tendency to flow; to propagate beyond its immediate origin. The interconnectivity of such spaces is reflected in the interconnectivity of the potential hazards to which they are exposed: crowded places are "easily accessible, regularly available and…offer the prospect for an impact beyond the loss of life alone (for example serious disruption, or a particular economic/ political impact)" (Home Office, 2009: 3). Although loss of life in itself constitutes an impact of great severity, the potential for escalation lies in the 'prospect' of knock-on effects.

This understanding of risk is by no means restricted to the terrorism context. The *Public Safety in Complex and Built Environments* guidance, produced by the Cabinet Office in 2007,

seeks to outline good practice in preparing for and responding to the kinds of risks affecting large, high density, multi-occupancy and multi-use structures. More specifically, the guidance defines such an environment as having "one or more of the following characteristics:

- Large, complex structures with functional geometry related to the assembly, movement, processing and dispersal of large numbers of people.
- Multiple activities and embedded business functions that may be subject to different regulatory regimes.
- High density and a high level of diversity of occupancy and usage.
- Diverse, multiple and/or fragmented ownership, management or tenancy." (2007: 3)

The definition covers a wide range of different spaces. For instance, many 'crowded places' would also be included in this classification, especially under the first and third characteristics. However, complex and built environments display an additional focus upon 'fragmentation' of responsibility: those facilities which are owned, regulated and/or operated through a mixture of different agencies, both public and private, *but whose continued functioning nevertheless has broad societal significanc*e. Notably, it is pointed out that, "from a strategic resilience perspective, such facilities may be important in macro-economic and political terms. Indeed some, such as major transportation hubs and systems, may be a vital part of the regional or national infrastructure". This economic and political significance is the first of two related reasons for which such facilities are seen to warrant attention. The other is the idea that, as a result of the social and spatial complexity of these environments, risks take a form which is particularly difficult to calculate and manage.

In complex and built environments, "the main risks to public safety stem from interactions between masses of people, the built environment that surrounds them and the systems embedded in it or interlocking with it – such as means of mass transportation" (2007: 5).

The problem arising from this situation is that risk, traditionally conceived as the likelihood and severity of a particular event, is destabilised:

> "Multiple interactions magnify and compound the overall level of risk, which can increase exponentially with the size and complexity of the environment. Thus, the level of risk can change rapidly and disproportionately in response to minor variations in prevailing conditions" (ibid.)

Assessments of risk here become slippery and unreliable. What may initially be a small or low-risk event can "create a disproportionately great effect", and as such "the margins between safety, danger and disaster can be narrow, unstable and even unknown" (ibid: 11, 5). Complexity can bring a newly catastrophic potential to hazards which would otherwise be considered regularly occurring but manageable. The guidance asserts, for instance, that in complex and built environments "fire is the most potent risk owing to its multiple effects. Flame and smoke are potentially lethal. Smoke degrades visibility, obscures visual safety instructions and disrupts control. All of those effects can induce distress and panic" (ibid: 11). It is thus the knock-on effects of a fire, as much as the initial threat it poses to life, that constitutes its severity. Through its interactions with other structural, functional, and social elements such as crowding, architecture, lighting, ventilation, signage, and so on, a risk such as fire may not only rapidly spread but also rapidly transform into something qualitatively different. To expand further upon this idea, it is necessary to return to the disaster which was – as a direct reference in the above document indicates (ibid: 5) – a key influence in its formation: the King's Cross fire of 1987. This being a fire in a London Underground station, it also provides a useful introduction to the contested conceptions of risk which have characterised that space in particular.

A Tale of Two Fires: Dynamic Risk and the Threshold of Disaster in the King's Cross Underground Fire

> "The flashover divided the Underground into two worlds, each believing it had lost touch with the other. Those on the surface believed that those beneath were trapped or probably dead: those beneath had no idea what was happening above. Their sense of detachment was complete"
>
> (Fennell & DfT, 1988: 79)
>
> "In emergencies, risk becomes dynamic. New risks emerge, previously recognised risks recede and the balance between risks changes continuously"
>
> (HM Govt., 2013: 17)

On November 18th, 1987, a fire exploded across the ticket hall at King's Cross Underground station, killing 31 people. The fire was deemed to have started when a match, dropped by a passenger lighting a cigarette upon leaving the station, passed through the small gap between the tread and the skirting board of the Piccadilly Line escalator, igniting the grease and detritus accumulated below. The report published by Sir Desmond Fennell the following year found that the problem lay not in the rarity of fire on the Underground, but precisely the opposite: that fire was so commonplace as to be considered an inevitable and acceptable by-product of the system itself. As Fennell put it, in relation to an interview with then-Chairman and Managing Director of the Underground, Dr. Ridley:

> "It was…a matter of some concern to me that the directors of London Underground should still subscribe to the received wisdom that fires were an occupational hazard on the Underground. Dr Ridley did not feel able to agree with the Court that fire should be regarded as an unacceptable hazard to be eliminated, since it was considered that fires were a part of the nature of the oldest, most extensive underground railway in the world." (1988: 32)

As such, the approach taken towards fires was one suited to a typical risk event: a regularly occurring pathology whose frequency and effects could be calculated and prepared for. Fires were conceived as such a banal event in the context of the LU that they had in fact ceased

to be called 'fires' at all, but had instead come to be referred to by the euphemism of 'smoulderings' (ibid: 61). For Fennell, this demonstrated an attitude that was "seriously flawed because it fail[ed] to recognise the unpredictable nature of fire" (1988: 32), in other words, the possibility for 'smouldering' to evolve or slide into something far more serious than that term suggests. Examining the case of the King's Cross fire in greater detail, it is evident that this unpredictability arose out of an interaction of elements specific to the environment of the Underground station.

According to the timeline in the Fennell report, the fire started at roughly 19:25, and was first reported by a passenger at 19:30. Following further reports, two experienced firemen inspected the escalator at 19:43, with one quoted as considering it "not a big fire at all" (ibid: 93). However, "in a period of about two minutes or less, the fire observed by the firemen on their first arrival had deteriorated from what they perceived as a modest fire into a raging inferno" (ibid: 100). Between 19:43 and 19:45, there was a "sudden change in conditions…when a modest escalator fire transformed into the flashover which erupted into the tube lines ticket hall" (ibid: 16). Fennell considered this short period of the 'flashover' as a threshold moment at which the normality of 'smouldering' lurched suddenly into something (and some*where*) else; a different kind of fire and the emergence of emergency. As part of the inquiry, the escalator fire was simulated using a software modelling package named HARWELL-FLOW 3D, which sought to discover how it had developed to result in the flashover (ibid: 107). The results unearthed a previously unknown phenomenon, henceforth known as the "trench effect", wherein an assemblage of factors unique to the station environment – including the upward movement of a working escalator, the airflow caused by the ventilation system and the motion of the trains through the tunnels, and the chemicals in the paint coating the ticket hall ceiling – conspired to produce *an unprecedented dynamic of spread* (*see* ibid: 107-8, 113).

The Fennell report recommended a number of changes to LU's safety procedures, on the basis that "[a] mass transport service cannot tolerate the concept of an acceptable level of fire hazard" (1988: 32). As well as preventative measures to remove flammable materials, the recommendations included alterations to response procedures. Fennell urged LU to dispose of the term 'smouldering', and to more generally adopt a 'proactive' and 'open-minded' approach to risk. One of the most significant recommendations taken up was the reversal of the policy for fires to be treated, in the most part, by members of LU staff, with the London Fire Brigade (LFB) being called only when such attempts failed. Instead, the LFB would be called to the scene immediately whenever a fire was reported, such that each and every fire would be extinguished as quickly as possible, before having the opportunity to spread and, crucially, before reaching the sort of tipping point identified at King's Cross. As opposed to the conception of fires as an inevitable risk to be managed, Fennell stated the need for a different strategy, having, as its ultimate aim, "the elimination of all fires" (1988: 120). In practice, this would be both preventative and pre-emptive, acting both to reduce the likelihood of fires and, if fire did break out, to rapidly suppress it, at the first signs or suspicions of its emergence. This represented a transition in the conception of fire from an accepted and manageable risk – akin to the pathologies of population security – to an unacceptable danger to be eradicated. However, Fennell's approach, as it turns out, would last for only four years, before another incident drew attention to a new set of risks, themselves arising as unintended consequences of the very safety precautions introduced to eradicate the possibility of the original risk-event.

	Primary	**Secondary**
Form of Levée	Construction and Design of LU as subterranean network, i.e. beneath the surface of the city	Measures and procedure for suspending and evacuating the network in the event of an incident
Risk(s) Intended to be Mitigated	Disruptions of urban life, eg: - Traffic congestion - Political and social disturbances (crime, protest) - Weather conditions - Geographical complexity - Architecture (housing and other buildings)	Risks of the system (*inc. primary levée effects*), eg: - Fire - Overcrowding - Derailments - Collisions (with passengers or other trains) - Bombings - Explosions
Levée Effects (risks produced)	Risks of isolation and disconnection, eg: - Overcrowding - Psychological factors: Entrapment, Disorientation and claustrophobia - Communication difficulties	Risks/costs of service disruption: - Economic costs (to operator; to urban and national economy) - Risks of disruption: trains in tunnels; trapped passengers; knock-on congestion

Figure 8: Primary & Secondary Levée Effects of the LU

> "An event doesn't just begin and end. It is a flow of something else. Geographically, temporally, culturally, they all flow into eachother, even though we think they're separate".
>
> (Interview 4)

On February 19th, 1991, one day after the bombings of Paddington and Victoria stations by the Provisional IRA, the discovery of an unattended briefcase at Bond Street station triggered a succession of events on the Central Line. As a precautionary response services on the line were suspended, and as passengers were evacuated from a train at Liverpool Street a second briefcase was left behind. With the line at a standstill, there were more trains than there were stations to unload at, leaving seven trains stranded in tunnels between Liverpool Street and Bethnal Green (Appleton, 1992; Interview 7). LU's normal procedure in this kind of situation was to bring the stranded trains together such that passengers could use them as a bridge, walking through them in order to escape without being exposed to live rails. However, as the subsequent Health and Safety Executive report – carried out by the chemical engineer Brian Appleton – put it, "[t]hat is a tricky process, itself not without risk" (1992: 2). When it was attempted on this occasion, "one of the trains involved went too far, the two trains touched and led to an electrical short circuit. This caused electrical resistors on the second train to smoke and for that smoke to drift down the tunnel, giving reasonable suspicion that there was a fire" (ibid.). This suspicion in turn led to power on the line section being turned off, meaning that trains could no longer be moved, and the 6000 passengers had to be evacuated by walking through dark, smoke-filled tunnels.

Echoing Fennell's analysis of the King's Cross fire, Appleton found that, though in this instance the only human consequence was 70 people taken to hospital for heat exhaustion, "[t]he incident could have ended in an unparalleled disaster and…well illustrates the way

that different kinds of risk can interact" (1992: 2). However, in this case the interactions were not merely at play in the formation of an initial hazard, but also in the formation of a range of knock-on effects by which the event slid towards a (potentially) catastrophic form. Moreover, it was not only hazards which interacted with one-another but also *the measures put in place to mitigate or control them*. Thus, the event demonstrated "how the actions taken to guard passengers against one risk can create other hazards" (Appleton, 1992: 2).

If the design of the Underground as a subterranean system of secured urban circulation produces a primary set of levée effects through its isolation and inaccessibility, then the interaction of security measures to produce other risks serves to illustrate a further, secondary set (*see* Fig. 8). On one level, this is expressed in the ever-present possibility of unintended consequences; the fact that *risk mitigation produces risk*. More fully however, this process should be understood as the interplay of circulations. Analogous to the way in which, a number of years later, regulatory regimes on food safety would lead to intensified mobilities of livestock spreading 'foot and mouth' across the UK, efforts to achieve safety on the Underground system by shutting down its system of flows serve to produce other flows of a more intensified and potentially unruly kind. As exemplified by the Central Line incident, evacuation is foremost among these second-order circulations, being the most visible manifestation of an emergency flow, that is, a flow produced by the disruption of flow.

Particular consideration is given to evacuation in the *Complex and Built Environments* guidance, wherein it is emphasised that evacuation is not a solution to a problem but rather "a risk in itself, and [one which] carries a high potential for hurting the people it is designed to protect" (2007: 12). In any complex environment, evacuation is likely to mean multiple flows which have the potential to collide – both the various flows *out of* the environment in

question, and flows, for instance of police and emergency services, likely to be heading in the opposite direction. In addition, since such spaces are marked by their *extensivity*, evacuation, contrary to its common interpretation, is not equivalent to escape. It is "the start of a process, not an end in itself" (ibid: 18). Planning for evacuation therefore includes consideration of the means by which these flows can themselves be processed, regulated, and controlled, bringing in further procedures such as "shelter, information, immediate care and onward movement" (ibid.). More broadly therefore, the document warns that in complex and built environments:

> "risk management strategies must be coherent and integrated at all levels of the organisation and between partners, because *the results of such a dynamic process never exist in isolation*. Risk management activity always effects the environment in which it operates and an attempt to mitigate risk in one area will impact on the distribution and intensity of risk overall" (2007: 12. *Emphasis mine*).

As such, the treatment of dynamic risk demands a multi-agency approach, taking account of the fact that, even with what appears to be a small incident, effects (including evacuation) may spill out beyond the bounds of any single, geographically or functionally contained authority. Continuing with the metaphor of the levée, risk is characterised by *flow under pressure*. While a certain risk in a certain area can be suppressed, the force of this action will intensify the pressure elsewhere, creating another flow of a possibly very different (and perhaps more dangerous or costly) nature. The greater the overall pressure of the system in question – the closer to capacity it is, and the more interconnected it is – the more sensitive it will be to these kinds of redistributions, and the more rapidly their effects will transfer and transform.

As we will see in the following sections, London's transportation, and particularly the Underground, is an especially high-pressured system in two senses, one socio-technical and

spatial, the other economic and political. With regards to the former, the enclosed and densely populated nature of the network means that any suspension of the system leads to the rapid development of widespread disruption and associated risks; with regards to the latter, economic and political dependence of London and the UK on the Underground system imposes 'unrivalled' pressures on restoring services in a timely manner. Together, these factors mean that the rapidity of response is particularly critical. This is turn produces a basic tension informing the governance of the Underground system: the tension between the imperative for speed of response on the one hand, and the imperative for decisions which are informed by strategic and specialist knowledge, on the other.

5.3. Infrastructural Resilience and the Underground: The Need for Rapid Response

> "History has taught us to expect the unexpected. Events can, and do, take place that by their nature can not be anticipated exactly. Response arrangements therefore need to be flexible in order to adapt to the circumstances at the time while applying good practice, including lessons from previous emergencies, and safeguarding the UK's constitutional settlement."
>
> (Cabinet Office, 2013a: 5)

In the literature review it was described how the CCA and the all-hazards, effects-based, resilience approach to emergencies came about through the failure to respond adequately to a particular set of mobile and rapidly developing events around the turn of the millennium. The CCA relates to the governance of emergency on the London Underground inasmuch as it sets out the duties of Category 1 responders, such as the police and emergency services, as well as Category 2 responders, including operators of critical infrastructure such as TfL. The practical application of the CCA in terms of response capabilities however should be seen in the context of what is called Integrated Emergency Management (IEM) (Cabinet Office, 2013b: 8). This set of principles is worthy of attention

especially because, as a simpler and more comprehensible idea than the Act itself, it is referred to more readily by practitioners (Interview 2). IEM consists of six key steps: anticipation, assessment, prevention, preparation, response, and recovery (Cabinet Office, 2013b: 8). Whilst the first four steps are explicitly stated as statutory duties in the CCA, the latter two – response and recovery – are advised upon only through non-statutory guidance. However, this is not due to their being in any way less important, but rather that while processes of assessment and preparation can be outlined in advance, response and recovery need to some extent to be tailored to the event in question. Thus, "[t]he underlying aim of IEM is to develop flexible and adaptable arrangements that will enable an effective joint response to and recovery from any emergency" (Cabinet Office, 2013b: 8).

In the more specific context of infrastructure, this flexibility is especially important due to the unpredictable nature of dynamic risks. According to the Cabinet Office guidance on *Natural Hazards and Infrastructure*, infrastructure resilience is comprised of four principal strategic components which map loosely onto the above components of IEM: resistance, reliability, redundancy, and response & recovery (2011b: 15-6; *see* Fig. 9). The focus of both resistance and reliability is to ensure protection and continuity of function in the face of regular events or fluctuations in prevailing conditions. It is notable that, consequently, both are compromised by their dependence on archival-statistical forms of knowledge. Resistance strategies "have significant weaknesses as protection is often developed against the kind of events that have been previously experienced, or those predicted to occur based on historic records" (ibid: 15). Such an approach by itself is inadequate because it fails to take into account the potential for "[d]isruptive events [to] exceed the standards provided for protection thus resulting in loss or damage and significant impacts" (ibid.). Likewise, "[t]he tendency of a reliability strategy is to focus only on the events within the specified range,

and not events that exceed the range" (ibid.). Resilience therefore involves measures to cope with *excess risk*; with that which escapes protective approaches.

In the recognition that "[e]vents can, and do, take place that by their nature can not be anticipated exactly", the capacity to respond to incidents as they develop is crucial. Rather than a reactive process, response is intended to consist of procedures which act on the 'within' of the emergency. The Cabinet Office (2013a) identifies two closely-linked challenges here: First, 'crisis management', "the phase of the response that attempts to prevent or avert an immediate emergency, along with the protective or other measures put in place to mitigate its effects, prevent further damage or disruption and secure the scene" (ibid: 6). This phase in other words consists of measures which attempt to *contain* an incident. Second, the document refers to 'consequence management', which it defines as "steps taken to prevent the impact of an incident escalating. It includes managing wider consequences and services such as restoring transport networks or electricity supplies, managing community relationships, and providing shelter to displaced persons" (ibid: 7). This phase holds subtle but important differences from crisis management in that it acts on the event in the recognition that its effects are difficult or perhaps even impossible to contain, and must therefore be managed more flexibly and on a wider scale.

In the context of infrastructure, these processes are embodied through a particular importance attributed to the latter two components of resilience listed above – to redundancy, and to response & recovery. In the event of disruption, these components aim to minimise the impact upon circulation and the delivery of the service, to isolate the disruption and to curtail it as quickly as possible. Redundancy contributes to resilience by enabling circulations to be re-routed in the event of disruption. It is hence thought of primarily as a physical property dependent upon 'network design standards', and referring in

particular to "[t]he availability of backup installations or spare capacity [which] will enable operations to be switched or diverted to alternative parts of the network in the event of disruptions to ensure continuity of services." (Cabinet Office, 2011b: 16; 30). The shortfall of redundancy lies in the fact that, although it can put in place the potential for circulations to be redirected, the act of re-routing itself implies disruption to services for the time it takes to identify alternative routes and then to redirect circulations through them. The severity of this problem varies depending on the speed and flexibility of re-routing, and this in turn tends to fluctuate depending on the sector in question. For instance, whereas "[t]he electricity transmission and distribution networks in the UK are very effective in the ability to control and manage the supply of services to prevent disruption as a result of the design of the network…other sectors, such as water or transport, have less opportunity for re-routing owing to operating at near full capacity and the costs of providing redundancy within the networks" (ibid: 30-31). In the most flexible of networks, such as telecommunications, "the switch over to maintain services is instantaneous" (ibid: 16). In less agile systems however, "redundancy strategies would lead to an initial loss of performance until the alternative infrastructure can be brought into operation" (ibid).

Figure 9: The components of Infrastructure Resilience (source: Cabinet Office, 2011b: 15-6)

On the LU, redundancy is especially difficult to achieve. Two factors are at play here. First, demand – in spite of a slight dip in ridership over the past few years – has followed an upward curve, whilst increasing capacity is a difficult and expensive process, meaning services operate close to capacity; second, *because the system is neither singular nor purely technical*, the ability to re-route circulations is dependent on (re)directing flows of human bodies – a relatively slow, fragile and unruly set of flows – around a system consisting largely of single, closed routes. The result of these factors is an imperative to keep the system moving, and to respond rapidly to any disruption, since even short stoppages lead to prolonged network-effects. As one interviewee described the situation:

> "We are in an incredibly congested environment – the significant number of people, of bodies, that we move from one place to another. I think it was 2 years ago now we went over 5 million [people per day], but we are averaging 4.8-5 million journeys on a daily basis. The [statistic] that I do like is between 8:30 and 8:45[am] at Waterloo station there are 520 people per minute entering the Underground. *So with that amount of people, you've got to keep the system moving. As soon as we get a stop*

> *in the system, it just causes us real problems*. That is one of the biggest challenges…we're underground, we're moving loads of people; if we get a blockage on one line you can't move around it, there's no way of diverting them down another area. So our whole ethos is trying not to have those disruptions, or if we do have that disruption, dealing with it as quickly as possible so that we can get them back moving again." (Interview 9. Emphasis mine)

A rail system is thus a system of planned routes in which spare capacity is at a premium. This contrasts, for example, to the flexibility of the bus network, wherein "if a particular road or area is closed off, they just go on a diversion, and go round it" (ibid.). Without rapid intervention to reinstate circulation, the pressure built through disruption to a single part of the network spreads. The objective of crisis management – to contain an incident to a certain area – is therefore rendered extremely difficult:

> "the Underground, because it's a network, and everything's interlinked, it's very difficult to contain anything. If you look at the national network as well. If you get an incident at Doncaster or Leeds, there is a knock-on effect at King's Cross, because that's where the service goes. And very quickly King's Cross will be full, and you won't be able to move trains in or out. So there is a contagion across the whole of the rail network." (Interview 10)

Whilst this seems typical of an instance of 'cascading failure', it is again a matter of socio-technical mobilities: the pressure of disruption is carried in the form of passengers, the density and force of mobile bodies endeavouring to get from one point to another. As a result, the connection between an initial event and its effects can be hard to establish:

> "You get an incident here, and the impact is felt over there. And you think: 'what's the link?' And it's people trying to work their way through." (Interview 10)

By way of illustration, one interviewee made reference to an incident two years ago, in which a disruption at North Greenwich on the south-eastern section of the Jubilee Line led to acute problems at Bank:

> "That's way back, it's another line. Bank got affected so so quickly and other people just wouldn't have recognised that that was an issue because we've got a bit of a problem on the Jubilee Line." (Interview 9)

Unexpected blockage to a system which, in addition to being designed for continuous, scheduled circulation, is also underground, quickly causes pressure to build in a way that distinguishes it from other complex environments, even other rail systems. This relates not solely to flows of people but also to their interaction with vital supporting infrastructures such as the flow of air:

> "being underground, it's a very different environment to a high-rise building. You've got to keep people moving. A lot of places the only ventilation is the train's moving, so as soon as you stop, the heat starts to go up." (Interview 10)

As a result of this particular problem, LU has, since the Bethnal Green incident, had standards for the maximum amount of time a train can be held in a tunnel at different times of the year before an ambulance needs to be called (Interview 7). Disruption, therefore, cannot be contained or tolerated for any considerable period of time. It must be treated proactively; the blockage solved and circulation restored.

The Economic and Political 'Closeness' of the Underground

The severity of disruption, and thus the need to rapidly restore the service, is compounded by London's economic dependence on the Underground's continued functioning. TfL is a statutory body, and as such is not subject to the private interests of profit-making in the same way as other parts of the railway industry or other infrastructure sectors. However, whilst largely freed from micro-economic pressures, LU is at the same time exposed to pressures at the macro-level; that is, from regional or national government. The closeness here is such that, although – unlike other sectors such as water and electricity – there exists

no statutory obligation for TfL or LU, in the event of disruption, to restore the service within a given amount of time, doing so is the absolute core objective of the organisation: "we would fail terribly if we didn't" (Interview 9). The answer to how quickly the service should be restored is therefore, simply, "as quickly as possible" (Interview 10). One interviewee drew a comparison on this point between London and Mumbai. Recalling conversations with Indian officials in the aftermath of the attacks on the Mumbai rail system in 2006, they revealed how powerful the imperative to restore the service can be, taking precedence over processes such as criminal investigation:

> "We spoke at length there to the Indians, and…one of our surprises was how quickly they restored the service. And their view was: 'we're the call centre capital of the world; we've moved x million people in, we've got to move them out, and that's much more important than details of forensic evidence'." (Interview 7)

According to the same respondent, a similar type of pressure is felt in the context of disruption to the London Underground:

> "The demand for the service to be running again would be very much like India. I mentioned the discussion with the Indians, and there was a moment in that discussion, where one of their Chiefs of Police said 'of course your system's very much like ours…what I mean is, it's integral to your economy'. So for things like 7/7, [and the failed attacks on] 21/7, the pressure to reopen, to have an operating system, didn't actually come from the operator; it came from government." (Interview 7)

The macro-economic importance of the system therefore potentially escalates the level of decision-making (if not formally, then by means of guidance, advice, or request) to a national political scale. The LU as a transport system in this way is unique in the degree of "closeness" it has to the economic and political functioning of the city it runs through:

> "It's a function which is not far disposed from Government. Not least of all of course is that if you're anything other than the top few ministers of state, you'll be travelling by the Underground everyday. There's a closeness of attention to it, which is just not rivalled anywhere else. You don't get members of the cabinet in the US travelling on the Washington Metro." (ibid.)

Moreover, it is not just at the urban scale that the effects of disruption to the LU are felt, the city being just the first link in the chain which ties the Underground to the continuity of government as a whole:

> "We can't have a democracy without a government; we can't have a government without a capital city; we can't have a capital city without the London Underground" (*quoted in* Interview 7)

What this all serves to illustrate is that, far more than merely a technical network for moving people around the city, the Underground is a social, economic and political space. As such, its resilience is conceived in terms that are applicable across public and private forms of ownership and management. Another interviewee for instance described resilience, both for government and for private firms, as being linked to the principles of crisis management and the prevention of reputational damage and financial loss:

> "You've got to think in terms of crisis management: the strategic objectives of the organisation. So if it's to make the best widget, with resources (and that includes people), then it's to make profit, and then why do you buy Dyson Airdryers and Dyson Hoovers? Reputation. They're the three drivers for a business. So if anything impacts one of those, that's where they need to show resilience…and it is actually the same for government…The strategic objectives for the UK Government are written in the National Security and Resilience Strategy. The short version is: to provide a safe and secure environment for UK citizens to go about their daily lives. And there's a whole raft of [factors included in that]. And obviously finance, whether its taxation or actually money coming into the UK stock exchange…[If] anything has an impact there, then [it will affect] the reputation of the UK…If you think things like

> the flooding, or the volcanic ash: it shut UK airspace. Significant impact on reputation…and it had a significant impact on the financial stability of the UK." (Interview 2)

What might be referred to as 'cascading failure' occurs here in terms of knock-on effects that are financial and reputational in character. Any significant disruption to the Underground would quickly have impacts at this level through the range of other services and infrastructures which depend upon it:

> "If you think of the Piccadilly Line, and the Paddington link to Heathrow Airport. If you don't get the passengers to and from the airport, the airport closes. It was, I think, £7 million every half an hour lost to the UK exchequer [if this should happen]. That sort of issue is the strategic issue that someone needs to be thinking about. It's about understanding the situation and its wider impacts." (ibid.)

In addition to a programme of infrastructure resilience or 'CIP' therefore, governing the Underground is informed by the principles of Business Continuity Management (BCM) on a macro-economic scale. For the business of government, the LU's uninterrupted flow is crucial, and as such any form of disruption is treated as a potential threat.

Having illustrated 'why' there is such a unique pressure to rapidly restore circulation on the Underground, more detail can be gleaned on the 'how'. How is rapid response executed? What are the characteristic apparatuses and forms of knowledge which enable entry into the 'within' of such quickly-developing events? In the following sections, I pick up on the importance of, and differences between, 'strategy' and 'situational awareness' in facilitating response on the Underground, and the specialist role of the British Transport Police (BTP) in pushing this mode of thinking forward through coordination with a range of other agencies. As a form of knowledge, this bears significant similarities to the 'system-vulnerability thinking' of VSS – in particular in its attempt to adopt a strategic calculative viewpoint of the network as a whole by assessing the interactions between its component

parts – yet it is at the same time distinguished by its emphasis on speed and flexibility: the need not only to model future vulnerabilities, but to respond to events as their effects spread and evolve.

5.4. The Network as a Whole: Strategic Thinking and the Danger of Operational Decisions

> "While the past can be a useful guide to the potential effects of an emergency, the complex interdependencies of modern societies make it more likely that emergencies will require a greater degree of inter-departmental co-ordination than might have been the case for similar events in the past"
>
> (Cabinet Office, 2013a: 36-7)
>
> "You've got to be careful about how you squeeze the toothpaste"
>
> (Interview 7)

When discussing the 1991 Central Line event in my interviews, attention was drawn to the failure to think each incident together with its knock-on effects on the network as a whole. As one interviewee pointed out, "each was treated as a separate incident, with people using phrases like '*to be on the safe side* we'll evacuate'; '*to be on the safe side* we'll shut the station'" (Interview 7). The singular perspective triggered a precautionary risk-mitigation approach embodied in the phrase '*to be on the safe side*', the problem being that, in such an environment, a 'safe side' as such does not exist; the notion of cutting one's losses is seen, on the contrary, to be a potentially disastrous way of thinking because it fails to account for the inevitability of levée effects.

This highlights the crucial role of strategic thinking in emergency response on the Underground: whilst the urge of operational or tactical command may be to take a precautionary approach, the role of the strategic is to make decisions based upon the consideration and calculation of possible network effects:

> "The challenging thing is…it's not one of those decisions *clicks fingers*. Because that decision *clicks fingers* is shut everything. That's easy, in fact that's the easiest approach. That could be quite a tactical or operational decision: shut everything. The more challenging thing is [asking] is that the right thing to do?" (Interview 2)

In terms of risk, this is a question of the responsibility for secondary levée effects; for the flows created by the decision to suspend the network. Despite the great deal of preparation and exercising done prior to July 2005, the response to the events of 7/7 again demonstrated a precautionary mindset which, if things had unfolded differently, could have had catastrophic consequences:

> "One of the scary things is, on the 7th of July they made the decision to evacuate the entire network. They have a responsibility for the health, safety and welfare of everyone they're evacuating...The whole network was evacuated. You've now got a quarter of a million people coming out of the network, stranded. They think once you close that door – if you take a cynical view – get them out of the network, because then you don't have responsibility for them. Whose responsibility are they? If something had happened that could have got rather messy." (Interview 2)

One has to be aware, therefore, of how risk is displaced across and beyond the network – about "how you squeeze the toothpaste". This necessitates a way of thinking that conceives events as continual flows which must be managed across institutional and geographical boundaries. One respondent was inspired in this view by their work in Qatar, where the extreme climate meant that, even on an everyday basis, evacuating people from a network (such as the new Doha Metro) without arrangements for onward movement would have severe consequences:

> [I]n Qatar, the temperature is very hot. So if they have an issue on the new trains…they can't do what they would do here and turf everyone out, because they would be turfing everyone out into a hot climate that is going to kill them very shortly. So it made me think of people as being like water flowing, so they have to

> flow to something. If something happens on the roads they flee into the tube station, if something happens on the tube they come out, but they still have to go somewhere. So it's thinking of it as being a flow, and it should all be joined together, and the plans need to be joined together" (Interview 4)

Because disruptions in this way produce unruly flows, and because "emergencies do not respect boundaries" (Cabinet Office, 2013b: 22), the flexible arrangement of response must take place across institutional borders. A flow does not escape but can only be said to be passed on, transferred, or re-routed. In all this, it must continue to circulate. It is this particular kind of strategic thinking which characterises the work of the British Transport Police (BTP), a specialism which lies in the aim of 'policing disruption'.

Policing Disruption: The Role of the BTP

> "Over the last 10 years BTP has assessed over 10,000 bomb threats and not once recommended closure. The financial saving for the rail industry achieved by avoiding unnecessary closure of the system through this approach is assessed in the billions of pounds. The wider economic benefit to the UK economy is higher"
>
> (BTP. *In* House of Commons – Transport Committee, 2014: 10)

So far it has been argued that the railway, and especially the Underground environment, produces, on the one hand, a dynamic form of risk, and on the other, an economic and political sensitivity to disruption. Together these factors lend themselves to strategic thinking, multi-agency coordination, and rapid response in order to maintain, quickly restore, or re-route circulation. These demands are embodied, on an everyday basis, in the work of the British Transport Police (BTP). The BTP is a unique force for a unique environment. In particular, it is a force specifically geared towards the policing of mobilities; of bodies on the move across space. Consider, for instance, this passage – a piece of

evidence supplied to a 2006 House of Commons Transport Committee report into the *Future of the British Transport Police* – which lays out some of the specialist risks and logics of response on the railway:

> "The railway "community" contains all the diverse groups of any other community in the UK, but with the added input of a specific railway operator's community, rail staff, tenants and contractors and rail passengers…In addition, the millions of passengers per day form another, transient community, most of whom live nowhere near the stations themselves…The railway itself attracts specific types of offending that are peculiar to its infrastructure. Offences such as trespass, vandalism and obstruction are dangerous to those who perpetrate them, but have a major safety impact with potential network wide implications to safety and disruption.
>
> …Good examples of this can be found in relation to offences known as "route crime" (trespass, vandalism, obstruction of trains, stone throwing). An effective response requires partnership amongst organisations to develop a range of measures that can be applied across normal administrative boundaries.
>
> In other examples, the specialist policing service brings with it attitudes that are borne from a highly developed awareness of the business impact of policing response and the need to return to normality as quickly as possible and avoid disruption." (2006: Ev.2)

To summarise, we might say that the railway is characterised by *a transient community*, and mobile forms of misconduct which have *wide-ranging network effects*, all couched within *a commercial environment*. These characteristics are linked to a specialist mode of policing orientated towards the minimisation of disruption. For instance, it is claimed that "[p]olicing and enforcement play an increasingly vital role in ensuring the reliability of the transport network, both surface and rail-based" (GLA, 2015: 44), and while other police forces focus primarily on crime statistics, the BTP has, as one of its key targets, the task of reducing disruption – measured in Lost Customer Hours (LCH) (ibid.: 43).

Due to the potentially-catastrophic effects of even small disruptions, the approach towards everyday occurrences on the rail and Underground networks must be reconsidered. For instance, one of my interviewees discussed work they were carrying out with a Train Operating Company (TOC) in London looking at transforming the approach towards caring for people who become ill on trains:

> "when somebody becomes ill on a train, a likely and a very frequent course of action is that the train is held in the station until such time as there is a response, and the incident is dealt with in myopic isolation, without realising that behind that train there's another train with many hundreds of people on it, and they will have medical difficulties as well, and behind that train there's another train, and another train, and another train. And so there are ways of much more efficiently and effectively patient-focused [sic.] dealing with this, which is primarily get the person off the train so the responders can deal with them on the platform, or move the train onto the next station where the responders can get there even more quickly." (Interview 3)

The necessity to think strategically, with network-effects in mind, causes friction with agencies that tend to function with an operational outlook or a culture of precaution. In this case, the medical principal of 'do no harm' is brought into question:

> "We then also have the situation of medical professionals turning up and saying 'no, you can't move the person', because there is a culture in medical training, that says 'do it this way'." (Interview 3)

The product of this kind of negotiation is evidenced, for example, in a Network Improvement guidance document produced by London Underground, in consultation with the London Ambulance Service (LAS) and St. John Ambulance, on 'What to do when a person is taken ill on a train'. The take-home point of this document, highlighted in a red text box and accompanied by a large exclamation mark, is that "In almost all cases where a person is taken ill on a train, they should be removed from the train to the station platform. If it is suspected that the person is having a heart attack, they can still be moved from the

train but they will need to be carried off". This reversal of medical principles is justified through the systems-perspective, wherein the circulation of the whole must be prioritised:

> "London Underground has a duty to provide support to all our customers, not only those who are taken ill during their journey. By moving the person from the train, the service is resumed more quickly and so:
>
> - the risk of other trains becoming stalled in tunnels, and the risk to our customers on those trains is reduced, particularly in hot crowded conditions
> - customers have less delay and inconvenience." (TfL – London Underground, n.d.)

As well as necessitating a strategic, network-perspective however, the specialist environment of the railway also works to different standards of speed. Processes such as crime scene investigation, and particularly the collection of evidence, must be especially rapid and flexible in order to minimise further disruption to the system. For instance, one interviewee hypothesised that:

> "If you went to a police officer…and said: 'give me some examples of perishable evidence', you'd get [them saying] bodily fluids and things like that. You wouldn't get: brake pressure testing from a train unit which has wiped somebody out on a level crossing and you've got to find out whether the brakes were applied by the driver. And you've got about 20 minutes to get that evidence. That's bloody perishable evidence!" (Interview 3)

As a result, multi-agency working methods have been vital in order to speed up processes of evidence gathering – not primarily in absolute terms, but in the sense of accelerating the pace at which the network is handed back to the operator such that services can be restored. In the case of a train crash, for instance, "there are various ways evidence can be collected. So of course [the police] can say 'okay, we'll give it back when we've collected the evidence'. Or [they] can say 'which bit do you need back first?'" (Interview 7). Communication between the police, emergency services and the operator is vital, in this

way, to facilitate the recognition of network effects and the minimisation of disruption in the response phase. The further acceleration of processes of information-sharing amongst response agencies is explored in greater detail in the following section. In particular, there is the idea that such processes need to be continuous, providing 'situational awareness'. This will bring us to an important theoretical point expressed in the differentiation between strategy and strategic- or systems-thinking – as a form of expertise associated with the planning or mapping of the whole – and the notion of situational awareness applied to dynamic risk, as a strategic view of the event *as it unfolds*. Whilst this latter capacity has tended in the past to be dependent on the leadership qualities of those in command, it is in the documentation viewed here also heavily linked to the role of information systems which allow data to be shared with particular speed, and enable actions to be taken by those on the 'frontline'.

5.5. Speed and Situational Awareness: The Role of Information Management

> "In many scenarios [response] is likely to be relatively short and to last for a matter of hours or days – rapid implementation of arrangements for collaboration, co-ordination and communication are, therefore, vital"
>
> (Cabinet Office, 2013b: 10)

A crucial component of preparedness in the CCA is the obligation, among Cat. 1 and 2 responders, to share information regarding relevant risks. This corresponds with the method, in VSS, of modelling 'system-vulnerabilities' by collating "an inventory of past elements at risk" and "information about the vulnerability of those elements"; data which is then combined, connected, and juxtaposed in the 'acting out' of the possible emergency (Collier, 2008: 226). However, information sharing is also an increasingly important feature of the response and recovery phases. As the non-statutory guidance explains, "[t]he co-operation and information sharing duties in the CCA regime are designed not only to

ensure there is a co-ordinated and consistent approach to preparing for emergencies but also to provide a basis for effective integration during emergency response and recovery" (Cabinet Office, 2013b: 9). Just as the emergency event "does not begin and end" but is rather a dynamic process, "[a]ctive risk assessment and management should be an ongoing process" (ibid: 17), applying techniques of calculation and modelling not only to the future event but also to the event as it unfolds; to the 'within' of the emergency (Anderson & Adey, 2012: 29). This calculative process is known as 'situational awareness': the "process of perceiving, comprehending, interpreting and evaluating what is happening in a crisis, combined with the ability to identify and model foreseeable future developments" (Cabinet Office & BSI, 2011: 5). Vitally, situational awareness is dynamic. It depends upon an ongoing assessment of the incident at hand, bearing in mind its potential to evolve in different ways, different directions. During a crisis therefore, it is recommended that situation reports be produced by separate organisations and collated, with the ultimate aim being the development of a 'common recognised information picture' (CRIP): "a pan-organizational statement of situational awareness, explicitly designed to support strategic decision-makers" (Cabinet Office & BSI, 2011: 16).

The requirement for situational awareness in the context of the LU is therefore indicative of the tensions between the overview of strategy and the need to make decisions and respond at a fast pace. While emergency is a short time-frame that begs immediate action, poor execution can lead to unintended and catastrophic consequences both short-term, and in the longer recovery phase. This tension is expressed in the scale at which responses are coordinated and carried out. Echoing the issues picked up on by the Fennell and Appleton reports between LU and the LFB, there is a difficult balance to be struck between response executed immediately by those on the scene, and the delegation of duties to individuals or agencies that have more specialist knowledge, experience, and strategic overview, but that,

because they are external to the system, will take longer to reach the incident. The culture of LU has changed to reflect this issue by putting an increasing degree of trust in frontline staff to make "fast-time decisions". Referring to the nature of the contemporary terrorism threat, one interviewee described this ethos as a way of coping with the disappearance of 'thinking time':

> "I think with the current threat, with the moving threat, and the fact that there could be simultaneous [events] as well, the thinking time has almost gone. Where we've now invested a lot of responsibility in a 24-hour senior manager on call to have quick decision-making 'up there', we're also investing it down the chain, so that the person in charge on the front line at the station can take preventative action. And it's very blunt what we do: we can either move people away from risk, which means putting trains in different directions or stopping trains, or we can evacuate stations. Actually, the [frontline staff] at the station can do that. They don't have to put that back up the chain and say 'can I have the authority to do that?', because that takes thinking time." (Interview 9)

The need for faster decisions to be made by frontline staff and first responders in the context of terrorism is also referred to by Lord Toby Harris in his review of *London's Preparedness to Respond to a Major Terrorist Incident.* In relation to the possibility of Marauding Terrorist Firearms Attacks (MTFAs), events that are seen as particularly dynamic and complex (2016: 9), Harris suggests a shift in approach from 'containment', a strategy which buys time for decisions to be made, to rapid response and 'neutralisation':

> "In the past, the normal tactics would have been to contain the threat and to place a cordon around whatever was happening. This might then be followed by an extended period of stand-off, perhaps with negotiations being attempted. In an MTFA, however…containment would not work. Indeed, such an approach would be likely to mean that most, if not all, of those within the cordon will become the victims of the terrorists. That is why the response to such an incident will now involve the first armed officers on the scene moving forward to confront the

> terrorists. Thus, the immediate objective will be to neutralise the threat as swiftly as possible, often using lethal force.
>
> These tactics will look and feel very different to the type of response we are used to from the police. Officers will be required to move into premises very quickly, making snap judgements to shoot suspected terrorists, which could have adverse consequences for victims if things go wrong. This would see them moving over dead and injured bodies to neutralise the threat, rather than stopping and helping victims." (Harris, 2016: 27)

The requirement for fast-time decisions or 'snap judgements' are, on the Underground, a matter of keeping the secondary levée effect of disruption to an absolute minimum. This approach is implemented through a graduated response process which works on the principle of 'subsidiarity': the notion that "decisions should be taken at the lowest appropriate level, with coordination at the highest necessary level" (Cabinet Office, 2013b: 14).[8] At the same time, however, this principle is scalable, and always contains the potential for escalation in the course of any given incident. The procedure in relation to an unattended item on the Underground was laid out as follows:

> "[P]art of the process is that we hope our staff deal with it first. So if they've got an unattended item we've got a process in place that allows our staff to give them the confidence to deal with it. And they deal with 95% of them. If they don't deal with that and they're concerned about it, they've then got the ability to ask for police assistance. That could be a uniform police officer with a little bit more experience, but it often, within London, resorts to the Specialist Response Unit, who have got more training, more equipment, more experience to be able to deal with it…If at any point the item is considered to be a threat, as in a confirmed explosive device or a biological or chemical device, then [the Met. are called in]." (Interview 9)

[8] It should be noted that this is a narrow definition of 'subsidiarity', a concept with a long and complex lineage (*see* Drew & Grant, 2017)

The Specialist Response Unit (SRU) – a broader term for TfL's aforementioned Emergency Response Unit (ERU) – mentioned by the interviewee here are a key player in this arrangement in a number of ways. First of all, they represent an assemblage of different specialist capabilities – BTP, LFB, paramedics, CBRN, and so on – meaning that they embody a high degree of strategic thinking in relation to the numerous possible ways in which an event might unfold or spread. Secondly, they are designed to be highly mobile such that their multi-agency nature does not hamper the need to respond at speed. Especially relevant here is the decision taken in 2012 to give the ERU the right to drive on 'blue lights' as police or ambulance services do (TfL, 2012). Thus, this form of rapid, multi-agency assessment allows the vast majority of incidents to be dealt with without the need for suspension or closure:

> "[Although] they're just an interim assessment (there's no render-safe capability)…by having that staged approach…we can deal with it very quickly – 99.99% of it. If we know that we've escalated it to get our Met. Police colleagues in as a render-safe capability, we know it's going to be a protracted incident, but that only happens such a small amount of times" (Interview 9)

We can conceptualise capabilities such as the ERU as exemplifying the idea of 'networks in embryo' discussed in the literature review. They are forms of multi-agency partnership designed to be triggered by the emergent event, and to respond rapidly in order to confront the incident as it develops. It is an approach by which 'snap judgements' may in some sense be strategically informed – informed, that is, of the need to resist the precautionary shut-down, and minimise disruption to the system as a whole. Approaches such as this also provide a possible alternative form of emergency governance to that based on preparedness exercises and enactments, focused instead on capabilities of 'rapid response' which work seamlessly across everyday and emergency contexts. What is important to note here is that the importance of such rapid scalability can be viewed through other lenses than that of

security, emergency governance, or 'resilience' in the strict sense. Specifically, it is an approach which brings with it distinct advantages when it comes to financial justification, making it an especially attractive approach in the context of economic constraints on public services.

5.6. The Decline of Enactment? Towards Rapid Scalability

There were suggestions, across my interviews, that strategic thinking and the ability to respond to unexpected and dynamic events was being compromised by the reduction in preparedness exercises, especially on a large-scale, multi-agency basis. Such exercising had previously been a vital part of how organisations prepared themselves to respond to uncertain futures, especially in relation to London's complex urban transportation environments. One interviewee for instance referred to the importance of the frequent and large-scale, multi-partner exercising driven by the leadership of the Met. Police in the late 90s:

> "They financed, encouraged, big partnership – not just meetings but exercises. We exercised for example at least twice on the Channel Tunnel, and it was about an attack on the Tunnel, an attack on the tracks going to the tunnel; the Underground, so many times; the Overground. Some of these were table-top exercises, but it also included a number of [live exercises]: 'Let's go and do something on a Saturday'" (Interview 2)

Another interviewee's account of an exercise, staged by a former employee of TfL, bears a striking resemblance to the aforementioned nuclear preparedness enactment described by Collier (2008):

> "We had a pre-Olympics multi-agency exercise at St. Ermins hotel near St. James's Park…[it] was about moving people and flows, and [the organiser] used coloured fish gravel, which he'd seen in a pet shop window, to simulate bulk and scale for populations. And he used different coloured plastic folders – the sleeves you put

> papers in to take to a meeting – and he cut circles out to the right diameter to fit over the area on the map. He procured the maps from the map centre. It cost a lot of money, but it would have cost a lot of money not to have done it that way" (Interview 8)

According to the first of these respondents, "[t]he challenge at the moment of course is that they're not doing these big exercises [anymore]" (Interview 2). This was corroborated by a number of other interviewees, one of whom pointed to the loss of BTP's specialist skillset – the ability, that is, to think strategically about the network-effects of disruption – as a potential consequence (Interview 3). When these concerns were put to those currently working with the Underground, it was explained that frequent, multi-agency exercises had been to some extent replaced by more focused work within the organisation:

> "No we don't exercise [as much on a multi-agency basis] but I think we try to target what we do a bit more." (Interview 10)

In particular, the aforementioned principle scalability – the idea that response to major incidents could be trained through everyday procedures rather than the simulation of future events – was put forward as an alternative to specialised exercising, underpinned by the philosophy that: "You practice for the big stuff in the daily implementation of your processes." (Interview 10). If the potential for rapidly scaling up response to any given incident is integrated into everyday operations, then there is less need for exercises which simulate or enact.

There were two main factors suggested for the decline in multi-agency exercising. Firstly, there was the notion of corporate memory, wherein because of a relative lack of large-scale emergencies or catastrophes on the Underground and rail systems over the last 10-15 years (arguably since 7/7), together with the fact that many people had since left the posts they held in that period, the awareness of the need to prepare for such events was receding.

One interviewee compared the recent situation to that of the 80s and 90s, a period in which train crashes (as well as, we might add, IRA bombs and bomb threats) were commonplace:

> "BTP especially got very good at dealing with train crashes, sadly. There was a period in the late 80s, early 90s, mid-90s, where there was almost one a year. And [the BTP] were excellent: the amount of corporate memory that they had to deal with that was almost second-to-none. As the railways have got safer, that corporate memory has gone." (Interview 10)

It may be noted that, in the absence of such events, it is in fact more important to exercise. The tendency, however, works in the other direction, particularly when it comes to financial justification.

Secondly therefore, the financial situation of public services in the context of austerity policies over the past decade – a context introduced in chapter three – has put growing pressure on agencies not only to justify their expenditure, but furthermore to judge each potential investment according to the need to increase everyday efficiencies and, ultimately, make cash savings by cutting costs. As an employee in emergency communications explained, financial imperatives come to take precedence over other metrics:

> "If you can show it genuinely saves cash, you'll get somebody's interest. If you can just show that it makes an officer's life easier or more productive because he makes more arrests…you might not actually get that backing because everybody's unfortunately concentrated on the bottom line.
>
> It's always been a bit like that, but in the last 8 years for the police it has been very bad. The Met. was told it had to lose 40% of its budget in 2010 I believe. And that was in my recollection the first time the government really have said: 'you're going to lose the money'" (Interview 5)

The demand to demonstrate savings in the delivery of public services clashes with the objectives of emergency exercising, whose large scale and uncertain orientation – towards a range of possible but unlikely futures – means that 'value for money' can only be proven retrospectively. Put bluntly: "In order to put an exercise on you need a budget. It takes planning, it takes finance" (Interview 2). Without this finance, alternative approaches become necessary.

If the principle of rapid scalability is what steps into the void created by drop-offs in multi-agency exercising, then this is a principle that demands greater attention. How does such an approach function, and what are its properties? As has been mentioned already, 'real-time' forms of communication and information-sharing play a crucial role, and this leads us, in the following sections of the chapter, to examine the place of digital technologies of various kinds in emergency governance and the governance of the LU more specifically. These developments can initially be read as indicative of the influence of 'smart urbanism'. However, my claim is that, looking beyond the technologies themselves, rapid scalability is enabled through ways of thinking and doing that attempt to integrate (spatially and temporally) strategic and tactical perspectives. As such, it is a distinctly logistical approach. This claim is not only based upon the apparatuses involved, but also upon the aforementioned duality of aims: the professed objective to *do more with less*, building resilience whilst at the same time exploiting possibilities for maximising value.

It will be recalled from chapter two that the entry of logistics and calculative technologies such as Total Cost Analysis from the military into the corporate sphere in the late-20th century was associated with the necessity to locate new sources of cost-savings and value-added in a period of crisis. It may be argued that the current entry of logistics firms into the provision of technologies and services for managing public infrastructure and emergency

response represents a similar pattern. It is a shift, in other words, driven by the imperative to find new ways of saving and making money, but to do so whilst maintaining or rather even enhancing resilience and response capabilities. In the vein of the logistical rationale, its aims are both negative (resilient to risk and disruption) and positive (opportunistically seeking possibilities for value-added).

As we will now see, the argument for upgrade and digitisation works through a broader discursive framing which presents the problems of public services and infrastructures as rooted in fragmentation and under-connection, leading to the positing of solutions in the form of integration, particularly through the connection and exploitation of information and communications systems.

5.7. Data Fragments: The Digitisation of Emergency Governance

> "Forces are awash with relevant data but not using it well"
>
> (UK Authority & Microsoft, 2016: 10)
>
> "Integrate Everything"
>
> (Thales, 2016a)

According to the *Emergency Response and Recovery* guidance, the process of situational awareness and the construction of a CRIP in the midst of an incident depend upon "the transmission and collation of potentially high volumes of information from multiple sources", the "assessment" of that information, and its "translation…into appropriate information products" (Cabinet Office, 2013b: 20). Additionally, it cautions that "[t]here is a balance to be struck between ensuring that decisions are well informed and acting swiftly and decisively. Establishing systematic information management systems and embedding them

within multi-agency emergency management arrangements will enable the right balance to be struck" (ibid: 21). In other words, information systems, like the relations between institutions, are intended to work as networks-in-embryo, having the potential to be coordinated across agencies such that, in the event of a dynamic event, relevant data can be brought together, assessed and distributed as quickly as possible without compromising its accuracy. In the Underground environment however, both speed and accuracy of information have long been significant problems owing to the aforementioned primary levée effects of the environment: its isolation and its unknown geography. Attempts to overcome these issues through technological innovation may be traced back as far as the introduction of the telegraph on the original Metropolitan Railway in 1863 (O'Neill & Bull, 2016), but ineffective communications have nevertheless remained a common theme in recent emergencies.

The gradual reform of communications on the Underground is marked, therefore, by increasing degrees of integration and interoperability among agencies. Facilitating this trend of integration is a parallel pattern: the growing influence of corporations and corporate logic. Before the process itself is even traced, this influence can be demonstrated by the fact that a prominent historical article charting the development of communications on the Underground, written by Karen O'Neill and John Bull for the transport magazine London Reconnections, is sponsored by the Thales Group, a French private logistics, security and defence giant which – as will be examined in more detail below – is engaged in projects on the LU and other public transport systems both in the UK and around the world. The background of Thales reveals traces of both military and business logistics. The company (formerly named Thomson-CSF) started out in the sphere of electronics and telecommunications (including radar) in the early to mid-20th century, but its profitability was established – following a brief period of nationalisation – by concentrating upon the field

of defence electronics across multiple domestic markets in the 80s. Subsequently, motivated by the fall in defence spending budgets in the 90s, Thales restructured to emphasise its "'dual technology' expertise", "focus[ing] its strategic development in civil markets on businesses with real synergies with the Group's proven defence and aerospace competencies" (Thales, 2019). Thales' recent projects for example include defence and security initiatives such as the development of the 'Tactical Battlefield Management System' – a mobile "real-time battlefield information-sharing app." – for the Canadian Armed Forces (Thales, 2018a), and the 'Ciudad segura' project in Mexico City: an initiative to reduce crime rates through a city-wide surveillance and sensor network (Thales, 2016b). At the same time, they are engaged in projects focused on enhancing the everyday efficiencies of transportation networks – for example Hong Kong's rail system, in relation to which Thales talk of "mining [a] 'data lake'", "[m]aking big data speak" and thereby "unlocking treasure" by monetizing the data to transform it into a "value-added resource" (Thales, 2018b). As will be detailed below, Thales are additionally a key actor in attempts to enhance signalling and monitoring of the LU.

In their article on the Underground, Thales construct a clear historical narrative: the story of a network in which the safe handling of disruptions is hampered by fragmented communications, and for which ever-greater levels of integration is thus the logical solution. Just as in Marvin and Luque-Ayala's (2017) aforementioned study of Urban OS, the common enemy held to be shared across business and public services is fragmentation; the whole in need of connection. This is part of a wider trend whereby providers of public services are forced to find efficiency-savings whilst responding to increased demand; to *do more with less*. In this context, the calculative rationalities and technologies of logistics market themselves as capable of extracting surplus value from within existing systems. Setting out this viewpoint, in the foreword to the *Blue Light Futures* report produced by the private

emergency communications provider Airwave (as of 2016, owned by Motorola Solutions), Chief Technology Officer Euros Evans states that:

> "Technological advances are critical to the future of the emergency services. But our ability to apply, integrate and properly exploit these new technologies is even more crucial, especially at a time when budgets are decreasing and the risk to public safety is increasing." (*quoted in* Airwave, 2015: 2)

Along similar lines, a 2016 report on *Digitising Policing*, jointly produced by UK Authority and Microsoft, paints the lack of integration as a historical problem hindering the function of policing, arguing that "[t]he fragmented structure of the country's police service has often undermined the cause of efficiency" (UK Authority & Microsoft, 2016: 5). The product of this fragmentation is *wasted data*; data which falls into the cracks between agencies. It is an asset which is being produced but not sufficiently exploited. As such, "[d]eveloping the interoperability between…disparate systems will *make it possible for one to interrogate the other* and help the force make the most of their human assets" (ibid: 7. Emphasis mine). Like Amoore's (2011) data derivative, this process is an asset built relationally, out of the 'interrogation' of one dataset by another. As such, it works on emergent data and relies to a lesser extent on historical information.

Crucially, it is proposed that integration simultaneously forms the basis for rapid information sharing, assessment and distribution in an emergency, *and*, at the same time, makes financial savings by increasing everyday efficiencies. Access to a broad range of databases enables a more flexible and immediate response. In a basic example referred to by one of my interviewees, it was described how, in the case of the police stopping a car, technological advances meant access to a wide range of information from the scene of the incident:

> "For many many years we've had the police national computer, 30 years or more. You can do a check on somebody, see if they're wanted, and you can check the

> vehicle...Certain things you could obtain that was it. Now you can do that, but you can also check all sorts of other databases within your own police force or wherever, and you can get a vast amount of information back" (Interview 5)

At the same time, integration is said to allow for the more efficient distribution of resources through the monitoring of officers themselves. As the *Digitising Policing* report claims, "[w]hile police forces are at the forefront of collecting data on criminal activities…they have been slow to examine the possibilities of using their business data to provide a new level of intelligence" (2016: 10). For instance, data sharing between operational and back-office functions, and between forces, might "provide valuable insights to support operations in areas such as the migration of officers from different sections or one force to another, sickness patterns, fleet management and the use of equipment" (ibid.).

In a striking parallel with the governance of workers in the logistics industries, with integration comes the potential for intensified monitoring in the interest of increased efficiencies. At the extreme of this idea is what Thales call their 'Connected Officer' (Fig. 10): the fantasy of a smart logistical being perfectly integrated into multiple real-time feedback loops. In a quite vivid illustration of how the digitisation of policing and the urban possibly paves the way for their corporatisation (*see* Kitchin, 2014), this being is presented as a product – a new release, 'by Thales' – composed of a number of other products; a package of various hardware and software components.

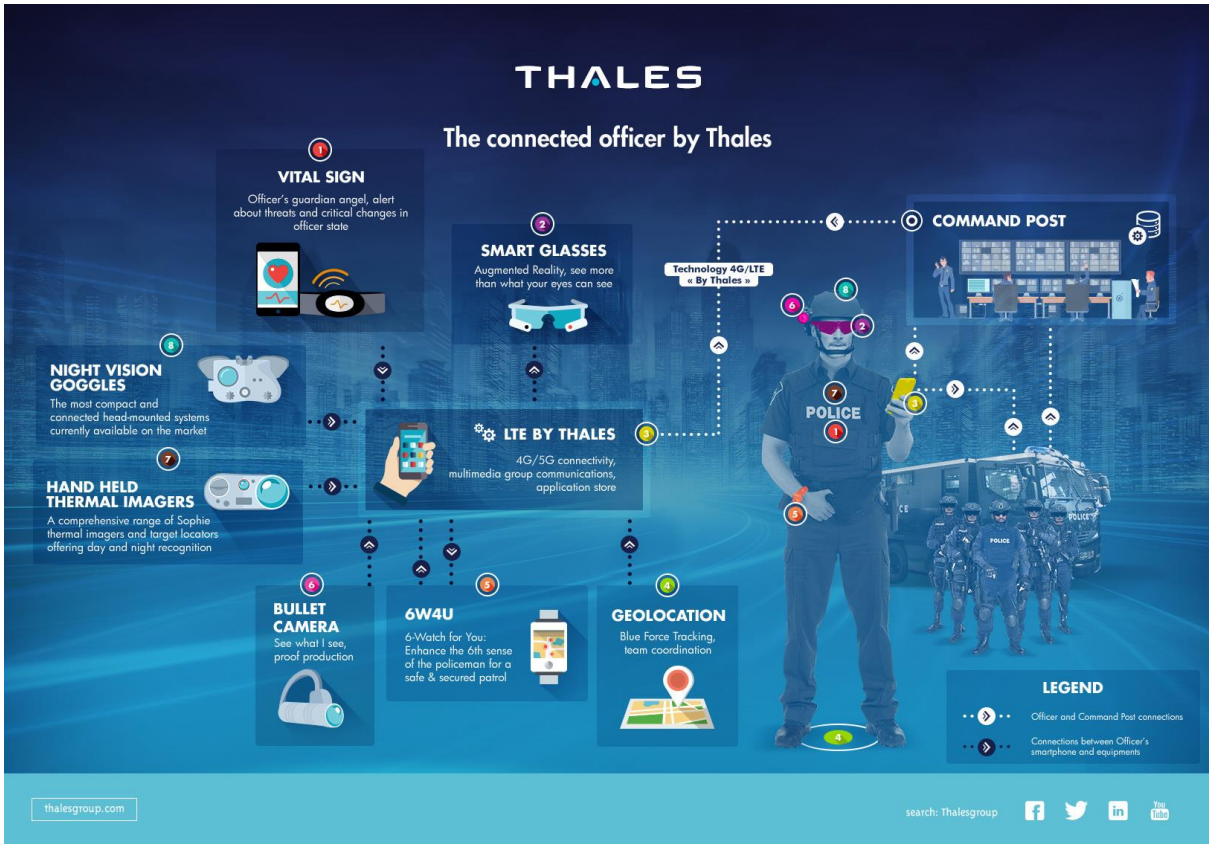


Figure 10: Thales' 'Connected Officer'

The distinguishing feature of logistics is, then, the promise of seamless integration between the emergency and the everyday of circulatory regimes. One does not have to trade off against the other. What are the more specific manifestations of these broad trends in the context of the LU? I argue that they take three forms: firstly, the integration of emergency communications systems and their outsourcing to private telecommunications firms. Secondly, programmes to upgrade signalling and centralise control centres, making the systems 'smarter' with the ambition to increase efficiency and capacity from within, as well as creating the ability to continuously monitor and respond to disruptions in real-time. Third, the opening up to WiFi and open data applications in order to continuously monitor mass passenger movements, and allow passengers themselves to gain continuous access to a

systems-perspective of the network on the move, enabling not only planning but re-planning of journeys.

Moreover, each of these three small case studies demonstrate different apparatuses characteristic of what in chapter two I introduced as 'logistical power'. The first develops 'networks in embryo' through the interoperability of communications systems across agencies, facilitating the rapid construction of situational awareness in the response phase. The second enables a continuous and real-time view of the system as a whole, including emergent disruptions. And the third distributes this real-time, whole-system perspective to passengers, producing novel tools of self-conduct and the impression of meaningful action. Additionally, and as the subsequent chapter will cover in greater detail, this final case in particular is beginning to emerge as not only a means of ensuring resilience or increasing efficiency but also as an opportunity for additional revenue streams.

Upgrading, Integrating and Outsourcing Communications: From 'Connect' to the Emergency Services Network (ESN)

> "'Dare to share' not 'need to know'"
>
> (Interview 4)

The response to the King's Cross fire was hindered by issues of communication: the fact that passengers reporting the fire did not know how to identify the location of the escalator in question, police officers present could not use their radios underground, and neither the police nor the LFB were familiar with the geography of the station (Fennell & DfT, 1988: 16, 75). In the aftermath of the fire, rail regulations were altered to require station radio throughout the entirety of any station, and at the same time work was undertaken to help

BTP radios to function underground (O'Neill & Bull, 2016). Whilst radio functionality now existed however, it remained fragmented. Towards the end of the nineties, "over 130 separate communication systems existed across the network", and although BTP radios worked, those of other forces did not (ibid: n.p.). Thereafter followed the 'Connect' project, the chief objective of which was to both upgrade and integrate the entire Underground radio network using a secured TETRA (Terrestrial Trunked Radio) system. Connect was based on a 20 year, £1.2 billion contract awarded (through a Private Finance Initiative) to the CityLink consortium in 1999 (ibid.). The consortium comprised Thales, HSBC, the private infrastructure company John Laing, and the telecommunications firm Motorola.

Despite the significant improvements made by Connect, communications problems were again a feature of the response to the Underground bombings of 7th of July, 2005. The failure of radio systems, especially in tunnel sections, led to a situation in which emergency services personnel and LU staff had to run back and forth from the sites of the incidents to ticket hall level to communicate with their senior command on the surface (O'Toole. *Quoted in* GLA – London Assembly, 2006: 15). As such, the 7th July Review Committee's report earmarked the extension of secure digital radio to the subterranean environment for all agencies as a top priority, bearing in mind both the possibility of "a future emergency", and "the efficient and effective management of the network on a day-to-day basis" (GLA – London Assembly, 2006: 15). This led to a further round of integration, with the radio system provided through Connect being linked into the National Policing Improvement Agency's (NPIA) 'Airwave' radio-replacement project. As a result, "[b]y the end of 2009 London, for the first time in its history, had a fully shared and integrated system of radio communication across the entire Underground and all of the emergency services" (O'Neill & Bull, 2016: n.p.).

Again however, it has been questioned whether this capability is sufficient for the current demands on response. Accompanied by a cultural shift whereby "there is growing support for a more bullish attitude towards sharing data…that places more emphasis on the duty to do good than the duty to avoid harm" (UK Authority & Microsoft, 2016: 8), emergency communications technologies are working towards the ability to work with data across agencies in real-time. Particularly in the context of responding to incidents in the Underground environment, the Lord Harris review for instance praises improvements being made to mapping technologies and tools of situational awareness by the BTP:

> "Many stations are large and complex, and so it is encouraging that the BTP are improving the tools available to them for situational awareness and ensuring that officers on the ground have access to the relevant plans and maps that would allow them adequately to search stations to confront terrorists within them. The MPS should learn from the mapping technology being developed by the BTP and introduce similar systems for major sites in London such as shopping centres, large entertainment venues and even museums and galleries" (2016: 24).

Pertaining to this ambition, the Home Office are currently in the process of upgrading communications once more, replacing Connect's TETRA-based system with the Emergency Services Network (ESN), to be operated by EE. This system will, it is hoped,[9] be able to access 4G signal and thus allow for the transmission of data (ibid.). As Harris points out, this would mean access, above and below ground, to live mapping technologies, CCTV feeds, and a variety of other instantaneous analytics via communications with control centres and other agencies. It would thus allow for the interconnection of different forms and sources of data, working relationally to construct an image of the event as it unfolds and provide the basis for fast-time decision-making. Where Met. Police officers already have access to

[9] There have, however, already been a number of delays to the implementation of the ESN, as well as a high degree of scepticism as to whether it will function as well as Airwave.

locational tools, for instance, it enables instantaneous, two-way feedback between the operational frontline and the strategic overview in the control centre:

> "Within the Met, you now have the opportunity to link up different technologies in a more effective way…[s]o something using GPS which gives you your location [is] now able to link into radio, so that with the same device you [can] both talk to somebody, and get your location and send that to the control room where somebody could see it on a screen" (Interview 5)

However, the ESN is significant not only because of its real-time data capacities, but also because it represents an unprecedented outsourcing of the UK's emergency services communications to the private sector:

> "[I]t's about the facility to do so much more with data. But it's also about the Met. and all the police forces and most of the agencies letting go control. They had their own technological operations that set up networks and did everything. They then outsourced them to a certain extent. Then they outsourced the actual network to the NPIA, and now you're talking about outsourcing not just to the NPIA, which runs – [or rather] Airwave runs for them – a closed, dedicated, private network just for the emergency services and other customers. You're now moving to something that's run by EE. So it's another huge step in terms of what you're prepared to allow the private sector to do…So it's partly the technology and what it can do for you, but it's also about the environment in which that sits" (Interview 5).

Through the proposed need to "do so much more with data", to increase efficiencies and hasten response, an argument is made for increased privatisation of the communications used to govern both the everyday and exceptional response functions of police and emergency services. The second case study below demonstrates how a similar argument is made in relation to the governance of the rail and Underground networks.

Dispersing and Centralising Control: 'Smarter' Trains and the LUCC

In a 2016 article titled 'Growth Signals', Thales proudly describes a further partnership with TfL delivering its 'SelTrac' communications-based train control (CBTC) technology on the Underground's sub-surface network: the District, Circle, Hammersmith & City, and Metropolitan lines. Already installed on the deep-surface Jubilee and Northern lines, this system is "an advanced signalling technology that makes it possible to increase the frequency and speed of train services on existing lines" (Thales, 2016a). In addition to using 'moving block' technology, meaning that "each train on the system knows where it is and constantly calculates the appropriate safety gap between itself and the train ahead", SelTrac will also integrate the thirteen control rooms currently monitoring this particular group of lines into a single control centre, "provid[ing] London Underground with a system-wide view of the sub-surface lines for the first time". This unified system of supervision enhances the ability to spot and respond to disruptions in a rapid and coordinated fashion. As Thales themselves put it, "[t]he ability to visualise and control everything from a single point matters because the four lines are highly interdependent and disruption on one line can quickly spill over onto the others". As one of the article's sub-headings ('Integrate Everything') suggests, this project is notable for its emphasis on establishing connections between pre-existing objects and systems. Through an example of what I earlier described as 'calculative retrofitting', the costs which would otherwise be incurred by attempts to physically increase capacity and provide redundancy are negated. The "capacity enhancements" come, as it were, from within.

Logistics companies such as Thales thus bring the calculative rationalities of business logistics to bear on the operation of public infrastructure. In a similar project being proposed for the UK's rail system (titled *Digital Railway*), the upgrade of signalling and traffic management software is put forward as a cost-efficient way of increasing capacity. Simply put, by allowing trains to be run closer together, digitisation and automation can increase capacity without

having to invest in the construction of new or larger lines. Integration and real-time communication between trains and control centres thus proposes to make the most of existing assets (*see* House of Commons – Transport Committee, 2016a). As opposed to the inflexibility of physical infrastructure, this data, it is claimed, can bring agility and speed to the governance of the system.

In the LU context, the SelTrac system follows broader trends seeking to integrate the surveillance and control of London's transport systems. In 2013, a new £25 million London Underground Control Centre (LUCC)[10] was opened at Palestra House, in Blackfriars, bringing together five previously separate facilities (Clark, 2016) including the Thales Network Management Centre (NMC) (O'Neill & Bull, 2016). Together, these centres monitor the entirety of London's transport network, including CCTV and social media feeds (House of Commons – Transport Committee, 2016b). Although the centralised approach was initially met with concerns over security, Palestra is seen as being crucial for making different agencies rapidly accessible to one-another in an incident:

> "a lot of people were saying: 'you're putting all your eggs in one basket', but it was deliberate because we've now got our 24 hour control centre, next to it is the police team; you've then got the power control so if you've got any issues with the power you've got the team right next to you that can deal with that; we've then got the people that deal with all our radios and all the communications underground; we've then got our central fault recording centre, and then, on the other side we've also got our track access team." (Interview 9)

Another respondent described Palestra as "the beating heart of the Underground" (Interview 10), not because of its operational work – all the Underground lines are run from separate facilities – but for its "strategic overview" and the resultant ability to manage

[10] This was the setting for one of the vignettes in the introductory chapter.

incident response. In a parallel capacity to the ERU therefore, the integration of monitoring agencies helps to hasten response and minimise disruption by enabling the rapid coordination of agencies. This in turn means that monitoring of the whole from a central, remote point can take the place of potentially disruptive interventions. In Thales' work on the LU, O'Neill and Bull (2016: n.p.) for example note the trend towards "remote event notifications and diagnostics. This has resulted in much more centrally managed activity and less in the field", matching the need to "plan, diagnose and proactively respond in a timely manner whilst not disrupting operations".

Monitoring of this kind is notable in how it centralises a plethora of different data sources into a single control centre, and for the continuity of the strategic calculative viewpoint it provides. It allows, in other words, for the juxtaposition of data previously used to model or enact possible future events, to be executed in real-time, providing the ability to respond with near-instantaneous speed to emergent disruptions. The third case, below, demonstrates how such logistical rationales are furthermore being used to engage passengers, and exploit the data produced through that engagement both in the service of the network's resilience, and in increasing and producing new sources of revenue.

Enrolling the Passenger: 'Connected London', Tube WiFi, and Open Data

> "We provide a world class transport system, but the Underground tunnels are one of London's largest not spots" (TfL, 2018a: 7)

In 2018 the Mayor's Office published the *Smarter London Together* roadmap (GLA, 2018). As a key component of the project, TfL is enrolled in the ambition to create a 'Connected London' by increasing access to internet services across the city, eradicating so-called 'not-spots'. The Underground here is presented as a 'lack' or absence: a system which is wasteful by virtue of its isolation. Where in physical terms this isolation cannot be helped, the LU can be reconnected to the city through digital means.

One of the ways of doing this is via the introduction of WiFi onto the network. Working in partnership with Virgin Media, TfL begun installing WiFi access points at Tube stations in 2012, and now boasts access on over 250 Underground platforms, allowing passengers to "[s]tay on top of [their] profile from 150 feet below" (Fig. 11; TfL, 2017). This project is clearly backed by commercial incentives, essentially doubling the productivity which the Tube allows – through it, the London Underground can be *both* a dedicated space of circulation, *and* a seamless extension of the office space. In logistical terms, this further integrates the commute into the whole of the urban economic supply chain, but it also does more than this. By enabling the transfer of data between the operators of the network and its passengers, it also facilitates the gathering and real-time calculation of the system's current status.

Placing the individual user within a feedback loop, the data which WiFi makes available to the passenger inevitably creates *passenger data* flowing in the opposite direction. This *inevitability* is what has been recently deployed by TfL both to carry out, and at the same time to discursively justify, a trial using the amassed 'big data' from mobile devices probing for WiFi connectivity to better-inform them of the circulation of passengers. In their report outlining the findings of the pilot, held over a period of four weeks in November and December of 2016, they describe the situation whereby WiFi "enables millions of customers to get online and find their way around using up-to-the-minute travel information". Invariably, they add, "[c]onnectivity data is generated *as a by-product* of providing this service" (2017: 13. Emphasis mine). Passenger data, imagined here as a happy accident, is then – lest it be wasted – creatively fed back in to enhance the provision of the service (see Thatcher, 2014).

In particular, such data improves LU's ability to monitor the movements of people through the system, both on an everyday basis, and in the midst of disruption:

> "We're certainly looking at journeys – using Oyster to give us journeys, but then working out how people got from end to end rather than going 'well, they must have gone this way' – Actually they didn't, they went all the way around the houses. So that's currently being looked at to work out why people travel the way they do." (Interview 10)

This is an advance on the Radio Frequency ID (RFID) data gleaned from Oyster readings, which register only the point of entry and exit – rather than being static, WiFi provides a dynamic mapping of movements (mobilities and their intersections) 'beyond the gateline', allowing for the calculation of how and where pressure builds and is released (*e.g.* Fig. 12).

Three additional points can be made about this technology. First of all, passenger data does not exist in isolation. It can be combined with the monitoring of the system's physical assets, allowing for the potential severity of emergent risks to be assessed. This is the case, for example, when it comes to assessing the 'loading' of trains and carriages:

> "[I]n the individual service control rooms but also within the main control room, we can look at individual trains and see how they're loaded: we can say, 'that's lightly-loaded, that's medium load, or that's heavily loaded'. We can get a really good feel of how many people are pushing around the system…If we've got a train there, and it's been stuck between stations in a tunnel for a while, but actually it's lightly-loaded…although it's still an issue to us, it's not as much of an issue as if it was very heavily-congested." (Interview 9)

Secondly, the uses of such technologies are by no means only security or resilience-focused. As well as managing disruptions, this information is commercially valuable. Not only does it potentially enable increased efficiencies by informing design and influencing the choices of routes taken; it also offers the possibility of extracting added revenue from passengers and

crowds through such mechanisms as the optimisation of ticketing and the placement of advertising (TfL, 2017: 43).

Figure 11: TfL promotional poster for station WiFi

Finally, it is crucial to note that, in spite of the seeming ambition to map all elements of the network, such techniques do not correspond with a strictly strategic, systems-orientated perspective. Rather than being located at the level of the system, the vital mechanism is that of feedback between the strategic and the tactical. The power of the system-wide perspective here lies in the fact that it is always on the move. It is constantly updated, and

fed back to the passenger whose data originally helped constitute it. The TfL website and mobile applications themselves are simple examples of this, made up of various colour-coded status updates, together with the 'Journey Planner'. However, what is particularly interesting is that a significant amount of this data is dispersed beyond TfL themselves. Vital in this way is TfL's Unified Application Programme Interface (API), which provides real-time schedules and disruption information as an open data source. The aim of the API is to help "stimulate new information products", giving private developers the opportunity to build software tools which use TfL's live updates to improve passenger experience, as well as to predict "[the] future status of the system at certain times" (Public Technology, 2016). Already, in 2016, there were almost 500 apps powered by TfL's real-time data, communicating disruption in a variety of different formats for a variety of needs (ibid.).

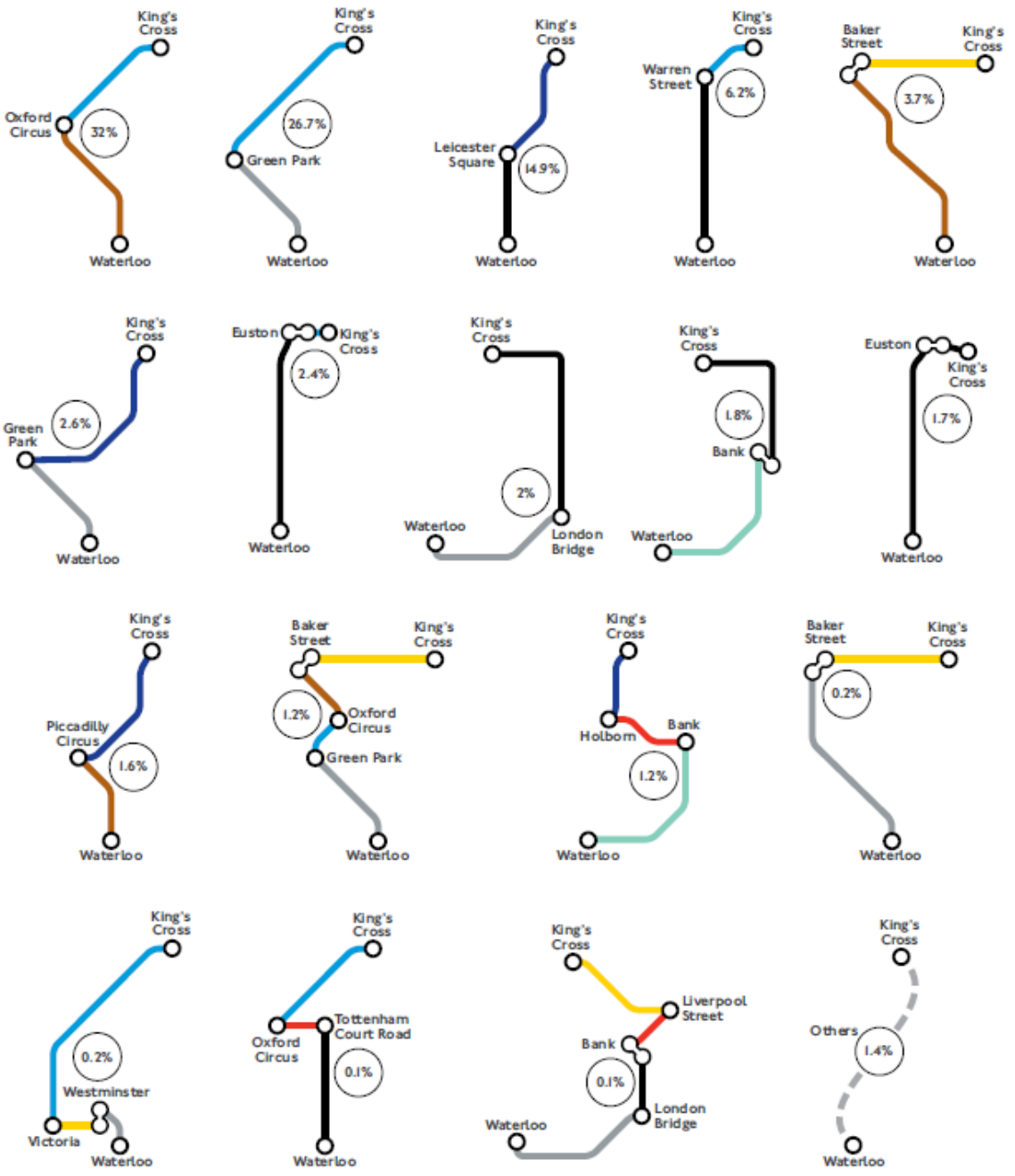


Figure 12: Diagram from the WiFi trials showing the route options chosen by passengers travelling from King's Cross St. Pancras and Waterloo whilst Euston station was closed on 30 November, 2016 (Source: TfL, 2017: 41)

In the concluding section of this chapter I wish to address the theoretical questions arising from the digitisation of the Underground's governance, in relation to the aforementioned frameworks of resilience, VSS, smart urbanism, and, finally, logistical power. If the form of power involved in governing the Underground is neither strategic nor tactical, but rather

logistical, then what does this mean for broader issues like the politics of urban space and urban subjectivity?

5.8. Conclusions – From the Diagram to the Interface: Control Society or Logistical Power?

Thus far in the current chapter I have tried to emphasise that the London Underground and what I have termed its 'dynamic risks' are more-than-technical; more than matters of closely-coupled systems and cascading failure. Rather, echoing Lipschutz (2008), the Underground is people! Relatedly, I have attempted to frame the current governance of the Underground and its risks as involving something that supplements a resilience approach and, although mobilising 'smart' technologies, is something other than a programme of smart urbanism. Specifically, I have identified a principle of rapid scalability executed through 'networks-in-embryo' and tools of 'real time' communication and calculation.

The ideas of scalability and feedback, which posit logistics as an oscillatory form of power, give rise to interesting considerations with regards to subjectivity. We can elucidate these issues by asking what role(s) and responsibilities passengers hold in the Underground's governance. The most basic responsibility may be identified as that of 'planning one's journey' by making use of Beck's Tube Map, as well as the digital tools mentioned above. As an act of strategy, this is something to be done before one undertakes their journey, either before reaching the station, or in its main concourse. However, we can also observe mechanisms which attempt to enrol or 'responsiblise' passengers more continuously into strategic-thinking; into thinking about the network-effects of their actions (*see* Ajana, 2005). The link between localised actions and impacts on the level of the system vary in their degree of explicitness. For instance, accompanying the aforementioned debate between the BTP and paramedics, we can identify the use of safety notices on Underground trains and platforms which ask passengers to "Please help others off the train if they feel ill" (*see* Fig.

15). The act of persuasion in this particular notice is communicated to passengers via the notion of individual care – "We can provide better care on the platform" – however, as we know from our earlier discussion, the intent has more to do with the wellbeing of the network as a whole. This example can in turn be related to a range of notices which attempt to make the link between act and system more explicit. For instance, signage which discourages certain actions (littering, leaving luggage unattended, obstructing the doors, etc.) tends to do so not by threatening fines or punishments, but by appealing to the network-effects of such actions, expressed in particular through the general formula "*x* causes delays" (*e.g.* Fig.s 13 & 14). This is of course both a reminder of one's participation in the network, of one's potential to cause disproportionate and dynamic effects, and an incentive to avoid delay. In this way, Underground subjectivity is akin to Reid's (2006) logistical life, as a responsibility to circulate with efficiency, but it is also more specifically linked to the forms of knowledge identified in VSS. In other words, the responsibility of the passenger as such is to participate to some extent in 'system-vulnerability thinking', conceiving of the space of their actions as a networked space and adjusting their conduct accordingly.

Figure 13: Responsibility for the network, part 1 (source: author's photo)

Figure 14: Responsibility for the network, part 2 (source: author's photo)

Alternatively, the processes of digitisation outlined above might tell a story of 'control' in the Deleuzian sense. The availability of data about the system and its passengers in 'real-time' opens up the potential for what Deleuze (1992: 5) referred to as "continuous control". In particular, the capacity of WiFi (as opposed to RFID) data to map passenger movements 'beyond the gateline' is strongly reminiscent of the shift away from the logic of examination (tests occurring at certain points in space and time) to that of tracking. This of course relates to Greenfield's (2017) assertion of the smart city as aiming for "nothing other than control", using technology and particularly the integration of databases and surveillance facilities to gain a centralised, complete view of the system. However, as we have already made clear, such an assertion is too u(/dys)topian; it does not recognise the extent to which logistics is built upon the calculation of frictions, and upon processes not just of centralisation but also dispersal; upon both centripetal and centrifugal force.

As such, we need to look beyond the binary of the strategic and the tactical to the governance which works across and between them. For instance, it was mentioned in chapter two that 'interface' is crucial to Massumi's 'connection fetish'. How does this phenomenon of interface work to alter our experience of tools of planning such as the map (or the map-as-diagram)? If the point of the strategic abstraction is to allow for the easy planning of routes, then what does it mean for this abstraction – as I said in my methodology – to be fragmented and dispersed; put on the move? For one thing, we can say that there is a shift in emphasis from the strategic notion of planning to the more resilience-focused, flexible notion of re-planning or re-routing from within. We can say, moreover, that the use of passenger data is potentially influential because it not only reminds passengers indirectly of their conduct with respect to the network, but in fact *demonstrates* it by showing passengers the live status of the system and their own position within it. As

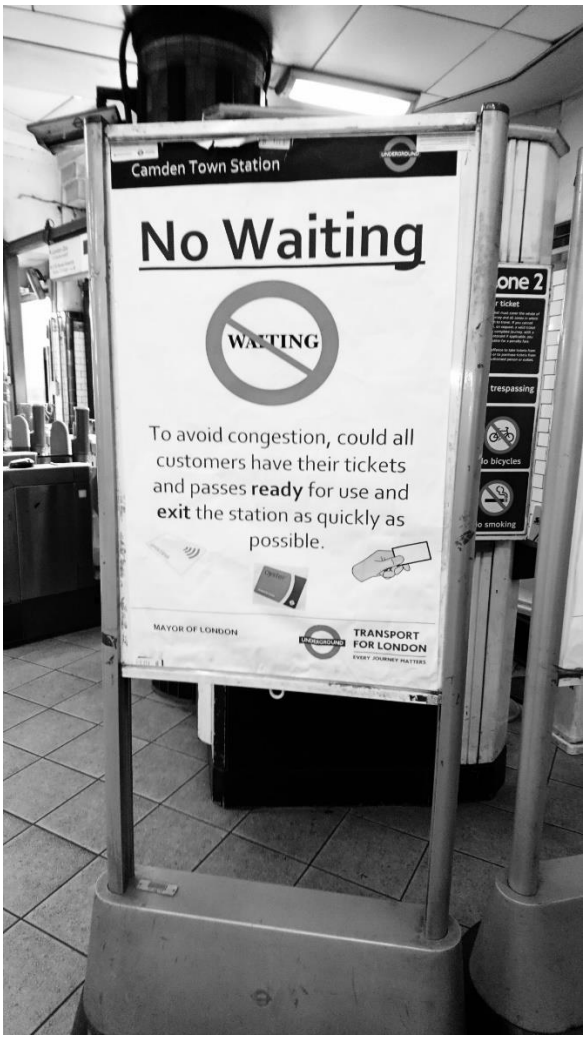
such, it provides tools of situational awareness with which passengers are able not only to *view* the network strategically, but also to *act* in relation to it.

Again however, we perhaps risk underestimating the frictious and partial nature of the Underground, in which uncertainty persists despite the growing digital connectivity of the space. Perhaps this is less about knowledge and more about reassurance, and less about the abstraction of a system as a whole than its fragmentation into palatable and momentary interactions; decisions capable of being made on the go. The fragmentation and mobility of the map, for example, is reflective of a broader shift in the nature of 'planning', mobility, and conduct. Rather than merely planning one's journey in advance, logistical perspectives mean having access to resources of knowledge with which to continuously re-plan or re-route. More than planning as a regimented, singular activity, urban infrastructural mobility is characterised by the necessity of 'checking' and 'updating'. These verbs denote a single act but imply a continuous and plural process. Like 'glancing' as opposed to simply 'looking', they are twitching, anxious acts of insecure knowledge which gain value through repetition.

In addition, thinking about these kinds of mechanisms as logistical means taking into account both the militarily-derived and corporate-focused aspects of its heritage, which is to say that they attempt to combine resilience and emergency governance (risk minimisation and management) with financial, revenue or profit-oriented targets (value-maximisation). These analytical objectives are taken up in the subsequent chapter through a focus on the material, aesthetic, and affective aspects of the Underground space, wherein it is argued that logistical power functions not only through systems-thinking but through iterative and performative moments in the daily experience of the space.

Figure 15: Responsibility for the network, part 3

6. The Design of Circulation: Aesthetics, Affect, and the Material Base of Logistical Power on the Underground



6.1. Introduction

"In their drive to quantify and optimize circulation, logistical imaginaries can only enact themselves through the production of space, thereby suturing a form of calculative reason premised on system-wide optimization to the reconfiguration of physical and social landscapes."

(Chua, Danyluk, Cowen & Khalili, 2018: 621)

"The idiom is more than a set of principles; it is a philosophy, an attitude and a way of thinking"

(*London Underground Station Design Idiom* – TfL, 2015: 30)

At the French Congress of Aviation in 1949, the genre-defining Modernist architect Le Corbusier proclaimed that airports should aspire to be "two-dimensional architecture"; they should be 'naked' (*quoted in* Gordon, 2008: 84). In other words, architecture's objective in relation to such spaces of speed and flow should be to make itself invisible. However, logistics and circulation are too often dissociated from the specificity of architecture and spatial design, as if Le Corbusier's plea had not only succeeded but had also led to the non-existence or irrelevance of those practices. Even if a space succeeds in being 'sterile', or in operating as a space of flow, this is only by virtue of its architectural, material, affective and sensual properties – a certain smoothness and shininess; an impermeability; a given arrangement of light; a careful delineation of walls and pathways, messages and signs. A focus on these material affordances serves as a way of drawing attention to the frictions and fragilities of circulatory regimes (Chua et al., 2018: 618; 625-6); not solely by studying disruption and breakdown (though this is, of course, a crucial task), but also by studying the roles of spatial, material and affective mechanisms in processes of abstraction, or in 'interfaces' for the management of friction. For again it should be emphasised that, unlike the phantasmagoric experiences of other urban infrastructures, transportation is a phantasmagoria that is at the same time physically lived and traversed. We walk its conduits; we, embodied subjects, navigate its labyrinthine innards. The abstraction therefore must be created and maintained; continually renewed, from within.

The current chapter thus builds on the intention, set out over previous parts of the thesis, to study the London Underground as more than just a miraculous process of A to B; more than a series of discourses or abstractions in the strategic sense. Thinking about and through a logistics framework presses upon us the need to consider the communications between an abstract whole and its material fragments; between panopticon and oligopticon;

or, more accurately, between circulations as system and circulations as bodily, multi-sensory performances. The theoretical precedent for this approach lies with the ideas of Lewis Mumford, Wolfgang Schivelbusch, and, latterly, Susan Buck-Morss and Paul Virilio. These theorists have put forward conceptions of modern forms and technologies (including those of mass transportation) as both productive of and dependent upon the abstraction of space, time and sense perception. For Schivelbusch (2014 [1977]), the railway specifically has been read as bringing into popular use a quantitative measure and experience of both time – as clock or schedule time – and space – as a network of departure and arrival points. My fundamental theoretical argument in this chapter is that, whereas the schedule and the network (or map) constitute strategic spatio-temporal understandings, the governance of the Underground is suggestive of mechanisms that are more iterative, partial, and sensory in nature. This is not to say that they do not involve abstractions – the Underground can certainly be productively thought through as a unique (but nonetheless historically and socially embedded) environment constituted and maintained through various processes of abstraction imposed on both time and space – but that they are, to a growing extent, more mobile and situational than a static view of the whole. Thus, whereas Schivelbusch draws on Mumford to argue that the railway as a form of machine has the effect of abstracting and standardising spatio-temporal experience; mass-producing and ordering place and time in a manner that typifies the shift from the 'eotechnic' to the 'paleotechnic' phase of technical development, it seems vital in the context of the Underground to consider in more detail Mumford's latter phase, the 'neotechnic'. For it is in this phase which we find a greater concern with form and shape, lightness and mobility, electrical power and its communicative potential. Rather than being premised upon standardisation, developments in this phase tend to hone experience of space and time in more minute, aesthetically and psychologically subtle ways. Specifically, it will be claimed that the Underground, in its growing logistical

ambitions – discussed in chapter five – to extract added value from the duration of circulations, ties neotechnic devices into constant relation with paleotechnic tendencies.

As a means for governing circulations, the Underground thus bears resemblance less to a strategic abstraction of the network as a coherent, smoothly functioning whole, and more to a continuous and iterative *management of friction* through mechanisms which work on an aesthetic as well as ideological or discursive basis. To elaborate upon these ideas further I draw on Susan Buck-Morss's (1992) notion of aesthetics and anaesthetics, together with Virilio's (2005a) understanding of the 'transport revolution' as involving an increasing dependence upon the cushionings and reassurances provided by various 'mounts'. From 'schedule time' and the network, I will thus move gradually over the course of the chapter towards what I will term 'countdown time', together with the notions of directional semiotics and (borrowed from Toscano and Kinkle) 'logistical images'.

Following on from the idea of 'interface' introduced in chapter five, the 'smart' technologies which facilitate real-time forms of calculation and communication should be seen in relation to a broader technics by which the London Underground as an environment seeks to optimise, maintain and recover circulations. This is above all constituted through a specific philosophy of design which, since the changes to the Underground system made in the first half of the twentieth century, has sought to integrate and optimise the efficiencies of the system. This 'total design' concept coordinates and orders the Underground's multiple functions. Its *modus operandi* is primarily visual, but it is not *only* visual. Rather, it also involves the deployment, in a regulated fashion, of a further range of aesthetic and affective mechanisms which take aim at senses other than sight, working through sound, texture, temperature, and so on. The chapter will argue that these mechanisms are designed to work in concert in order to continuously and immediately communicate to Underground

passengers the idea of the networked whole, encouraging onward movement and discouraging forms of hesitation, confusion, or prolonged cognition. As such, these mechanisms represent both precursors of and necessary compliments to the growing use of 'smart' technologies of monitoring and control: they are two overlapping phases of a broader logistical form of governance, animated by the connection between tactical and strategic perspectives, and the availability of information according to a 'just-in-time' model reliant on direct, near-instantaneous forms of communication.

More than just a regime of discourses or representations intended to portray and construct space as seamless and unproblematic, therefore, this chapter addresses logistics' capacities for continual (re-)ordering, iteratively and from within, in order both to manage friction, and to extract from it potential benefits. This is an argument that thus moves away both from the self-image of the 'logistics city' and the 'smart city' as seamless flow, and from accompanying theories of transport terminals as 'non-places' (Augé, 1995), instead taking a more nuanced view put forward, for instance, by Peter Adey. In his work on airport architecture, Adey (2008: 44) has argued that, although the airport terminal, departing from its origins as a viewing balcony for the spectacle of flight, has been sterilised and rationalised – "sensation, emotion and feeling…made surplus to value and function" – latterly there has been a kind of return of such 'irrational' characteristics in a different guise. As he puts it, "[t]he prerogatives of security, surveillance and consumption are being more closely re-routed through therapeutic, sensual and affective design technologies" (ibid.: 45). This phenomenon of return is something we will see once more in the Underground, the design of which seeks to engage the whole sensorium in order to encourage certain emotions and behaviours – calmness, vigilance, urgency, enjoyment, and onward movement, to name just a few. Since these emotions and behaviours appear at times to be at odds with one-another, the aim is to at all moments strike the appropriate balance between multiple elements.

Through the environment, various kinds of information and instruction – in particular, with regards to orientation, navigation, and safety – must be sorted, organised, balanced and hierarchised. Notably, this occurs both *on the move* (*kinaesthetically*) and via the (*synesthetic*) interplay of different senses, along with their (*anaesthetic*) regulation. It is not one, whole strategy of circulation, but rather a continuous stream or chain of signs and sensory cues.

In its complex totality, the Underground is often regarded as an exemplary case of coherent branding. But whilst in everyday parlance we tend to talk of 'brand image', the LU's attempts to regulate every aspect of its environment creates a *branded atmosphere* the extent of which is arguably unmatched in any other experience of everyday life.[11] Whilst there have been a number of news items in recent years which have highlighted the expanding scope of branding, from Cadbury's patenting of its particular shade of purple, to Nestlé's less successful attempts to do the same for the shape of the Kit Kat, London Underground and TfL have been doing similar things for far longer. Colour, shape, typeface: all these various aspects of the Underground are tightly regulated, and many are protected as intellectual property. There are two broad reasons for this level of care. The first is the obvious intent to create an attractive commercial vehicle in order to enhance reputation and maximise usership. The second, less obvious reason, we will argue, is that an instantly recognisable range of images, shapes, colours, sounds, and textures is integral to the very circulatory function of the Underground itself.

There are a number of specific elements which are especially significant in the production and maintenance of this environment. As was already mentioned in chapter three, the most frequently discussed is the aforementioned network diagram devised by Harry Beck.

[11] The supermarket and department store come a close second, with their strong and consistent use of particular colours for décor and own-brand product lines, the frequency of jingle-capped announcements; even the distinctive styles of layout. Yet even these spaces do not extend geographically in the way that the London Underground network does.

However, other crucial elements include Edward Johnston's sans-serif font, the famous London Underground 'roundel' (often described as the 27th letter of Johnston's alphabet (Long, 2011: 46)), and the station designs of Leslie William Green and Charles Holden. At an even more mundane level, we can add the regulated use of particular shapes – circles and rectangles especially – and the specific deployment of colour and lighting. What is perhaps more important than these elements individually is the ways in which they interact, dictated by the principles of balance and 'wholeness'. These overarching principles together with their more specific applications will be discussed in detail shortly. This will be achieved through reference to the modern development of the Underground, in critical comparison with a number of key contemporary guidance documents – in particular TfL's (2015) *London Underground Station Design Idiom* – as well as both primary and secondary visual materials, including photographs taken by myself in the course of my research, and posters and advertisements which have adorned the walls of the LU, past and present.

First, however, the chapter will place such relatively recent developments in historical and theoretical context. The Underground is not *just* a 'metro'; it is not a singular system or technology whose origins can be traced along a linear timeline. The Underground, for instance, is not an 'invention' of the 1870s; much as Peter Drucker (*quoted in* Toscano & Kinkle, 2015: 195) says of the shipping container, it is at most an 'innovation', the realisation in a more complete and secure form of a number of intersecting trends, desires, and capacities long preceding and spilling out beyond it. In particular, the Underground represents an extension, but also an augmentation, of urban logistical aspirations. It is in some sense the logical conclusion of a search for 'pure speed' and interminable circulation, and yet this longing for an immaterial cosmic destiny is founded and maintained through various and painstaking activities upon matter, and upon embodied experiences of movement. A brief look back towards the Underground's technical precursors will permit

us to demystify some of these processes, and thus to make important clarifications to the idea of logistical power. We begin, then, with the strategic abstractions of space and time instigated in part by the development and expansion of the railway in the 19th century.

6.2. The Clock and the Railway: the Production of Abstract Time-Space

> "Between the fourteenth and the seventeenth century a revolutionary change in the conception of space took place in Western Europe. Space as a hierarchy of values was replaced by space as a system of magnitudes"
>
> (Mumford, 2010 [1934]: 20)
>
> "the railroad – in realizing Newton's mechanics – negated all that characterized eotechnical traffic; the railroad did not appear embedded in the space of the landscape the way coach and highway are, but seemed to strike its way through it"
>
> (Schivelbusch, 2014 [1977]: 37)
>
> "we spare ourselves from the discomfort of pedestrian travel by manipulating the speed of movement…we play this game of hide and seek with our body which we call: assistance, comfort, support, well-being…*in order to feel our animal body less we are constantly on the move* (motility), *so as to forget the expanse of the territorial body, we travel rapidly, violently*."
>
> (Virilio, 2005a [1984]: 43)

In the above excerpt from his study of *The Railway Journey*, Wolfgang Schivelbusch refers to Lewis Mumford's tripartite articulation of the machine era as consisting of three successive but overlapping and intersecting waves. Supplementing Patrick Geddes' division of the so-called 'Industrial Revolution' into paleotechnic and neotechnic phases, Mumford adds the eotechnic, a preceding period of material and cultural preparation stretching from the 10th century up until the middle of the 18th, during which many of the technical advances – as well as desires, ideas and goals – usually associated with the 18th and 19th centuries were

developed in germ form (2010 [1934]: 3; 109). Each of Mumford's phases constitutes a 'technological complex':

> "Each phase, that is, has its origin in certain definite regions and tends to employ certain special resources and raw materials. Each phase has its specific means of utilizing and generating energy, and its special forms of production. Finally, each phase brings into existence particular types of workers, trains them in particular ways, develops certain aptitudes and discourages others…" (ibid: 109-10)

The eotechnic wave is characterised, in its materials, by water and wood, and, in its rationality, by the mediation of 'organic' elements and forces, derived from the heritage of handicraft industries. This mediation involves a certain degree of abstraction, wherein, for instance, a tree comes to be understood in terms of the properties of its material (as something called 'wood', with given strengths and weaknesses; a range of affordances) (ibid: 78-9). To take another of Mumford's examples, the use of glass in hothouses enables the dissection of environmental conditions: with it, one can have light and heat without rain and wind, thus extending growing periods in agriculture (ibid: 125). In terms of mobility and transportation, Mumford (ibid: 122) points to the river and the canal (bodies of water upon which wood can float) as the foundation of modern cities, reminding us again of Virilio's 'stopover'. Furthermore, he mentions the invention, as early as the 10th century, of the iron horseshoe which increased stability and grip, as well as the modern harness which improved the rider's control (2010 [1934]: 112-3). The horse here begins to be viewed not only as an animal – to be hunted, perhaps – but as a mode of transportation, a 'mount' (see Virilio, 2005a: 45-6).

The machine for which Mumford reserves the greatest significance however is the clock. Through his backward elongation of the era, he comes to claim that "[t]he clock, not the steam engine, is the key-machine of the modern industrial age" (2010 [1934]: 14). Beginning

with the use of bell-ringing to bring order to the life of the monastery from the 7th century onwards, the notion of time as an objective system was devised. With this, "the habits of adding time and saving time come into existence. Time took on the character of an enclosed space: it could be divided, it could be filled up, it could even be expanded by the invention of labor-saving instruments" (ibid: 12-14). Nonetheless, until the 14th century this quantitative conception of time would rely for its articulation on mediated but 'organic' readings vulnerable to disruption from the elements: "the clouds that could paralyze the sundial, the freezing that could stop the water clock on a winter night" (ibid: 14). The mechanical clock therefore achieved reliability through a further degree of abstraction, by modelling itself on organic time but at the same time divorcing itself from it. This abstract time would fast come to be thought of as much more 'real' than the organic cycles from which it was derived (ibid: 25).

The eotechnic period is viewed by Mumford as a greatly impressive and largely beneficial era, characterised by the intent to harness and adapt the inherent powers of the natural world for the benefit of society (ibid: 110-122). However, militaristic and capitalistic interests within Western societies have, Mumford argues, perverted the course of technics, leading to the paleotechnic phase, a period which he describes as "an upthrust into barbarism" (ibid: 154). Echoing the dual heritage with which I have viewed logistics, the typifying spaces of this phase are of the military, on the one hand, and of (carboniferous) capitalism, on the other; the battlefield and the mine. Its characteristic materials are iron and coal, and its rationale is that of standardisation, 'giantism', and "the quantification of life" (ibid: 85; 224). When coal begins to be used as a source of power in the 18th century, it builds a society around a logic of extraction, accumulation, and profit (ibid: 156-8). At the same time – and linked to the aforementioned mechanisation of warfare – the military from the 19th century onwards creates an insatiable demand for iron (itself produced from coal),

supplied to the front via the new railroad systems (ibid: 165). Crucially, however, the logics which characterise these exceptional spaces come to spread far beyond their bounds: "The practices of the mine do not remain below the ground", other environments are "exploited as if they were mines", beginning to resemble their atmosphere of brute force and sensory deprivation, and "[t]he nineteenth century town bec[omes] in effect – and indeed in appearance – an extension of the coal mine" (ibid: 70; 158-9; 163).

With regards to experiences of time and space, Mumford observes that "[t]he development of capitalism brought the new habits of abstraction and calculation into the lives of the city people" (ibid: 23). This in turn led the irregularity of eotechnic machines to be perceived as a weakness to be overcome. As Mumford says:

> "As society became more closely co-ordinated on the basis of time, the interruption in its schedules through the irregularity of wind and water was a further defect: the wind-mill was finally defeated in Holland because it could not conform easily to labor regulations. And as distances increased and contracts in business emphasized the time element, a more regular means of power became a financial necessity: delays and stoppages were costly" (ibid: 143)

Whereas eotechnic devices adapt to but follow fluctuations in input, the paleotechnic, in contrast, involves abstraction and standardisation, such that its devices appear to function independently of such environmental irregularities, producing output at a predictable and measurable rate.

The Railway as Paleotechnic Machine

The railway is seen by Schivelbusch in paleotechnic terms. Following its abstraction, the *standardisation* of clock time was accomplished through the first railways, the construction of which necessitated the accurate coordination of time in order both to provide information to a nascent population of passengers, and to prevent collisions (Schivelbusch, 2014). With

regards to our present case study, this can be thought of as the fundamental basis of a symbiotic relationship between material and immaterial circulations; between transport and communication. Such is the automation of the process today, that we tend to forget that time as we measure it is 'sent' from one place to another. This is much clearer when we read an account of the way in which, before the development of master-slave clocks, the time dictating the schedules of the fledgling Underground (in this case, the District Railway) was manually synchronised with the help of early telegraph systems:

> "At 07:58 every morning the telegraph operator at Westminster station took possession of one of the company's telegraph lines and 'held over' the signal – that is, sent a single, long pulse without releasing it. As stations and signal boxes listened in […this…] signal would radiate out from Westminster, lighting up other networks along the way as it was picked [up] by operators at Earl's Court and Mill Hill Park [now Acton Town] and echoed out onto their own independent telegraph systems. Then, as soon as Big Ben sounded the hour, the operator would release the line. At this signal railwaymen across the Underground would synchronise their clocks and watches, setting railway time for another day." (O'Neill & Bull, 2016: n.p.)

The Underground's history as a pioneer of communications technology can be explained in large part by this base need for time to be tightly and continuously coordinated across space. *In order to transport people and trains, one must first secure the transportation of time's measure.* In addition, one must encourage passengers to refer continually to this abstraction as the guidance for their actions.

However, the railroad does not only necessitate and facilitate abstract time; in striking its way through the landscape (rather than following and adapting to it, as the canal boat or the horseshoe does), the railroad marks also the abstraction of space, which becomes quantified as relational distances between places – now reframed as destinations, points of arrival and departure (Schivelbusch, 2014: 38; 42-3). As such it both engraves and embosses into the

landscape that quantitative set of relations first developed in the mind's eye in the Renaissance art of the 14th century through "the closer study of the relations of objects in space and the discovery of the laws of perspective and the systematic organization of pictures within the new frame fixed by the foreground, the horizon and the vanishing point." (Mumford, 2010 [1934]: 20). Perspective founded the possibilities, ideals and aspirations of connectivity, circulation and spatial calculation *prior to their concrete achievement*. As Mumford puts it:

> "[p]erspective turned the symbolic relation of objects into a visual relation: the visual in turn became a quantitative relation. In the new picture of the world, size meant not human or divine importance, but distance. Bodies did not exist separately as absolute magnitudes: they were co-ordinated with other bodies within the same frame of vision and must be in scale" (ibid.).

The railroad, by creating a form of movement which was regular and relatively predictable, allowed one to calculate their journeys; to schedule their paths across space; to see where one was going without necessarily having to pay much attention to how this was achieved physically besides the acts of boarding the train at the right time, and alighting at the correct stop.

The railway, in its impact upon the experience of place and space, is viewed as a typically paleotechnic machine. In significantly reducing the obstacles of space, and translating different places into a set of qualitatively indistinct points, the railway reproduces – perhaps mass produces – places as destinations, terminals, and stopovers. In illustrating this effect, Schivelbusch quotes Marcel Proust, who contends that, compared to the railway, the motorcar journey would be "in a sense more genuine, since one would be following more clearly, in a closer intimacy, the various contours by which the surface of the earth is wrinkled". The railroad journey, on the other hand, "seemed miraculous…not so much

because it covered a certain distance as because it united two distinct individualities of the world, took us from one name to another name…" (*quoted in* Schivelbusch, 2014: 39-40). For the abstraction to be accomplished effectively, in other words, the sensory evidences of movement itself must be suppressed, absorbed or deflected.

Schivelbusch's attention to the experience of travel corresponds to what Virilio says of the 'transport revolution', which he argues is characterised not simply by increases in speed but by various forms of 'mount', technologies which extend the range and power of the human body by liberating it from the work of movement, as well as from Proust's 'wrinkles': the ever-fluctuating relief of the earth (Virilio, 2005a; b). Again, this depends from the very beginning on a range of material developments. Following the early technical adaptation of the horse into a mode of travel, it is later transformed more and more from an organic being into a 'speed-factory' (Virilio, 2005a: 46); and, later, the organic origin is displaced altogether, substituted for the abstraction of 'horsepower' as a generalised measure of the engine, the regularity of which is, in turn, ensured through the building of smoother, flatter surfaces. Most of all therefore, it is in its levelling and clearing of the ground to make way for permanent routes – roads and tracks – that the transport revolution creates the seeming 'voids' within which smooth, regular speed is considered possible. These spatial and material processes are what lead to unique forms of perception. When we peer over the wall of a railway bridge or crane our heads from the station platform, we see space differently; we see space not as a series of contained land uses (buildings, parks, etc.) but as extension, speed. It is from the levelling, straightening and scraping of the surface of the route that we get this perspective, which is to say we witness the material manifestation of the ideal abstract view; of orthogonal lines moving towards a *vanishing point* (Fig. 16).

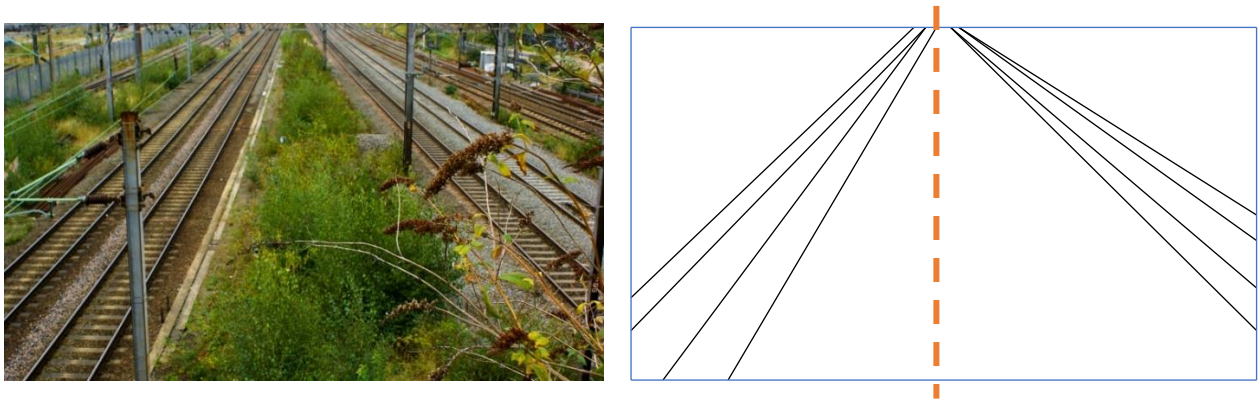


Figure 16: Railway perspective (source: author's photo and diagram)

The movement of transportation underground might, in this sense, be read as simply the logical progression of a rationale which aims towards absolute speed:

> "After penetration was substituted by encirclement, it seems that all of a sudden emptying out and piercing become a necessity of the speed of transport. The levelling off programmed by the railway was not enough, it was necessary to penetrate under the ground, *as if speed demanded not only the absence of obstacles but also the absence of matter*…
>
> …A prefiguration of the conquest of the atmosphere and space, where acceleration itself will become the path; the tunnelling [*percement*] of subterranean networks will be the unperceived logistical consequence of the progress of the violence of speed. …*Absolute speed necessitates the absolute void*, the increase in the performance of the engine goes along with the expansion of the desert. *After having contributed to straightening, then to scraping bare the surface of the route (roads, railways), the locomotive vehicle still demanded an airtight course, the production of a perfect void*" (Virilio, 2005a [1984]: 75)

Virilio's analysis, whilst it can certainly be accused of reifying what it critiques, is valuable in how it outlines the requirement for treatments of matter as a prerequisite to the creation, if

not of an 'absolute void', then of something which appears as or aspires to be one. Surfaces must be scraped and sanded, corners rounded off, and other, mediating materials and technologies used as buffers and mounts to lubricate friction and absorb shock.

The interdependence of abstraction and material change is very evident in the early decades of the LU, particularly with regards to its social and moral acceptability. For, as Pike (2005: 26) outlines, in the years preceding the opening of the Metropolitan Railway in 1863, the notion of subterranean transport was largely greeted with ridicule in relation to both the technical possibility and the social-moral plausibility of people (especially the urban middle classes) going underground. More broadly, the utopian modernism of the time sat uneasily with the longstanding associations between the subterranean and the organic. Even after the opening of the Metropolitan and District railways, the underground continued to conjure images of rats, darkness, disease, criminality, waste, leakage and other troubling things (ibid: 36). As opposed to the unobstructed visual materialisation of speed provided by the railway, the Underground draws eyes into pitch-black tunnels (Fig. 17). The aforementioned 'miraculous' feel of this infrastructure is constituted, it seems, through a kind of blind trust, detracting from our own lack of knowledge and control. Something had (and, in fact, still has) to compensate for this severe and repeated myopia.

Figure 17: Tunnel vision - the perspective of the Underground, as opposed to the railway, is myopic (source: author's photo)

For Pike therefore, the creation of a new, more acceptably 'modern' underground space in the 20th century was inextricably linked to the increasing prevalence of its abstract and *strategic* representation, in particular via Harry Beck's 1933 Underground map (2005: 20-3). An intentionally reductive imagining of the environment as a network, Beck's iconic map is characterised by the removal of extraneous information, the most striking of which is geography, or the multi-dimensionality of space (Benoit & Laver, 2011; Vertesi, 2008). Compared to previous attempts, Beck's diagram eliminated curvature, rounded angles to the nearest 45°, and equalised the distances between stations. The sole remaining geographical feature, the River Thames, is similarly squared, its meanders conforming to a legible grid. In addition, Beck's diagram omits volume and depth, simplifying the network to a single horizontal layer. All of a sudden, "the entire system…is conceived as if existing in a

subterranean space all its own", purging from the popular imagination the varying depths of different lines, and the coexistence of other infrastructures within its tunnels (Pike, 2005: 23).

The regularity and legibility of the diagram thus fills in for the absence of perspective. Further to this however, we can argue, following Lefebvre (1991), that the Underground increasingly conforms, materially, to its abstract representation, thus typifying the process of renewed fetishization associated with high modernity, "its obsession with clarity of form, purity, functionalism and cleanliness, translating the myth of the machine from the distant future into everyday experience" (Kaika & Swyngedouw, 2000: 132). Crucially, this transformation was enabled through a number of innovations around the turn of the 20th century – the electrification of the system, the introduction of ozonized air, and the eviction of rats – which attempted to sanitize the space, removing the sensory evidences of its organic elements (Pike, 2005: 38). In many ways this was a repetition of the processes which had previously sought to cleanse the surface of the city. The development of urban systems of water supply and sewerage in mid-19th century European cities, for instance, meant that the body's waste – its dirt and excrement – could be disposed of within the private space of the bathroom, and channelled out invisibly, creating a city surface free of the sights, sounds, and smells, of bodily excess (Kaika & Swyngedouw, 2000: 126). More fundamentally in the Underground's case, the exclusion of the organic meant the exclusion of *ground* itself, not just in the sense of the removal of earth, but also the removal of its unstable characteristics; its unevenness and irregularity. Virilio sees in the quip of an unnamed comedian a broader ambition of modern development: "The earth is flat, it's only round at its extremities" (2005a: 16). "This assertion", argues Virilio, "thumb[s] its nose at all relief", the geographical undulation of land which now "lies buried beneath the density of metropolitan infrastructures that have, it would seem, freed man from the irregular surface of the ground:

lifts, escalators of all descriptions, dirigible balloons, aeroplanes, helicopters" (ibid.). By the same logic, the exclusion of the organic from the Underground meant not just forcing out the rats and the darkness, but also obliterating *relief* in favour of a series of horizontal layers – platforms; ticket halls, etc. – traversable by way of lifts and elevators. As Sylvia and Alan Blanc note in their historical study of stairs, the aforementioned Frank Pick was one of the first to deploy 'moving stairs' on a large scale, with escalators installed by *Otis* on the Bakerloo and Piccadilly lines in the early years of the 20th century (2001: 183). In opposition to Virilio's description, relief has in this case not been buried; it has been bored through and extracted, dug out.[12] As Mumford notes, it is in this sense that the railway, the elevator, and thus also the subway, are all direct descendants of the mine:

> "From the mine came the steam pump and presently the steam engine: ultimately the steam locomotive and so, by derivation, the steamboat. From the mine came the escalator, the elevator, which was first utilized elsewhere in the cotton factory, and the subway for urban transportation. The railroad likewise came directly from the mine: roads with wooden rails were laid down in Newcastle, England, in 1602: but they were common in the German mines a hundred years before, for they enabled the heavy ore carts to be moved easily over the rough and otherwise impassable surface of the mine" (2010 [1934]: 158).

The mine typified the paleotechnic desire for a space of pure artifice and control, and in this way the Underground has always conjured utopian longings, hoping for a space of frictionless circulation. And yet what is very obvious in the Underground's case is that voids also need to be built and maintained. As we will soon illustrate, there is much more to the governance of the Tube than Beck's strategic representation. Although such transformations originate in the paleotechnic desire for standardisation, they are perfected, tailored, or

[12] Paradoxically, such processes today lead to the creation of *artificial relief* elsewhere. For example, the earth extracted from beneath the City of London in the current Crossrail project is being used to produce an RSPB reserve at Wallasea Island in Essex (Graham, 2016: 288).

maintained through what should be identified as a *neotechnic* set of concerns with the specifics of shape, form, aesthetics, and affect.

Paleotechnic Purposes with Neotechnic Means

Mumford associates the neotechnic age with a process of maturation, gradually displacing the militaristic and capitalistic obsessions of the paleotechnic with a more considered and humane complex. Whereas paleotechnic technologies aim to simplify and standardise through abstraction, neotechnic technologies are premised instead on a much finer scale of small alterations and marginal gains: a "respect for minute quantities" (Mumford, 2010 [1934]: 254). This era "gave to motors and turbines properties that had but a century earlier belonged almost exclusively to the clock" (ibid: 212). Here they take inspiration from detailed studies of organic phenomena made possible by the social and biological sciences. As Mumford says, this leads to a more general uptake of "an idea utterly foreign to the paleotechnic mind: the importance of shape" (Mumford, 2010 [1934]: 252). The priorities of neotechnic technologies are less concerned with 'big-ness', and far more with lightness and compactness; portability and flexibility, both in the materials they use, and in the modes of production, and type of worker they produce (*see* ibid: 226-7).

With regards to transportation, the study of shape is linked to that of aerodynamics, substituting the paleotechnic obsession with weight and power for the idea of a balance of forces. Thus, "[o]nly with the development of specifically neotechnic machines, such as the airplane, […developed out of exact observation of the bird's wings…] with the scientific studies of air-resistance that followed close on their heels, did shape begin to play a new role in technics" (ibid: 250; 253). This "esthetic [sic.] refinement of the machine" (ibid: 252) is associated with a range of characteristic materials, in particular those alloys and rare earth metals selected for their lightness and, in particular, for their ability to conduct electricity.

The neotechnic is thus based upon the potentials of conductability and communicability; the image is of 'energy flows' rather than 'solid matter' (ibid: 217).

The advances possible in the neotechnic phase were once more a matter of perception and calculation as well as material innovation. First of all, the capacity to make minute enhancements was inseparable from the ability to observe and to permanently record forms of movement. The photographic capture of a horse (as well as other animals) in motion pioneered by Eadweard Muybridge (1878; Fig. 18) was particularly influential, paving the way for minute analysis of the factors influencing 'horsepower'. These studies looked to abstract and scientifically dissect not just motion but 'locomotion' (*see* Mumford, 2010 [1934]: 251). From the Latin 'locus', meaning place, and 'motio', meaning motion, locomotion sutures place to speed, evaluating the living being not simply by its movements but by its ability to *cover the ground*, to get from one place to another. Secondly, the neotechnic, in its attention to shape and form, is expert in the art of appearances. It recognises the importance of presenting itself in an appealing way. It is functional but also aesthetic. As we will see shortly, this aesthetics should be understood in the full sense – or in the fullest sense of 'sense' – as involving not only sight but also a range of other bodily stimuli.

Despite Mumford's positive outlook on the prospects of the neotechnic phase, he warns that "*[p]aleotechnic ideals still largely dominate the industry and the politics of the Western World*" (ibid: 213); that, more often than not, what we are witnessing are "[p]aleotechnic purposes with neotechnic means" (ibid: 267). With specific reference to the railway, he argues that "the paleotechnic phase is still intact and all its essential characteristics are uppermost, even though many of the machines it uses are neotechnic ones or have been made over – as in the electrification of the railroad – by neotechnic methods" (ibid: 264). With this in mind, we can now turn back to our present case study.

The design of the particular composite of machines that is the London Underground has vacillated, since the early 20th century, across the intersection of the paleotechnic and the neotechnic, combining the force of brute standardisation with the detail, balance and flexibility of a far softer and more flexible set of architectural, sensory and affective devices. We can see this coexistence, for instance, in some of the points outlined in the previous chapter: the fact that the Underground is, more than any surface-based mode of transportation, and more than many other forms of infrastructure, a static and inflexible network. As such it is represented, read, understood and navigated via the strategic diagram. However, with its increasing degree of electrification and digitisation, some of this inflexibility is hoped to be compensated for: disruptions can be anticipated, responded to with rapidity. What is perhaps most interesting going forward though is that this latter aim of flexibility and responsiveness has not been restricted to the introduction of digital surveillance and 'smart' technologies; following Mumford's understanding of the neotechnic, we can see that attempts to bring flexibility to the Underground – particularly to the flows of its passengers – precedes those 'new' technics of the 21st century.

I point in what follows to a range of technics that seek to optimise the circulation of passengers by continuously and immediately demonstrating to them the 'wholeness' of the network, drawing them onwards whilst warning against the negative consequences of hesitation, idling, and other forms of disruption. Crucially, these empirical insights contribute to our understanding of the logistical as that which implies the whole not only by representing it as such (in the vein of the strategic), but also via a continuous stream or chain of fragmentary abstractions, encountered from within; from the ground and on the move. Initially, we will outline the broad notions of 'wholeness' and 'balance' upon which the Underground's design depends, identifying their key physical and spatial manifestations as the proliferation of rectangular and especially circular forms throughout the network.

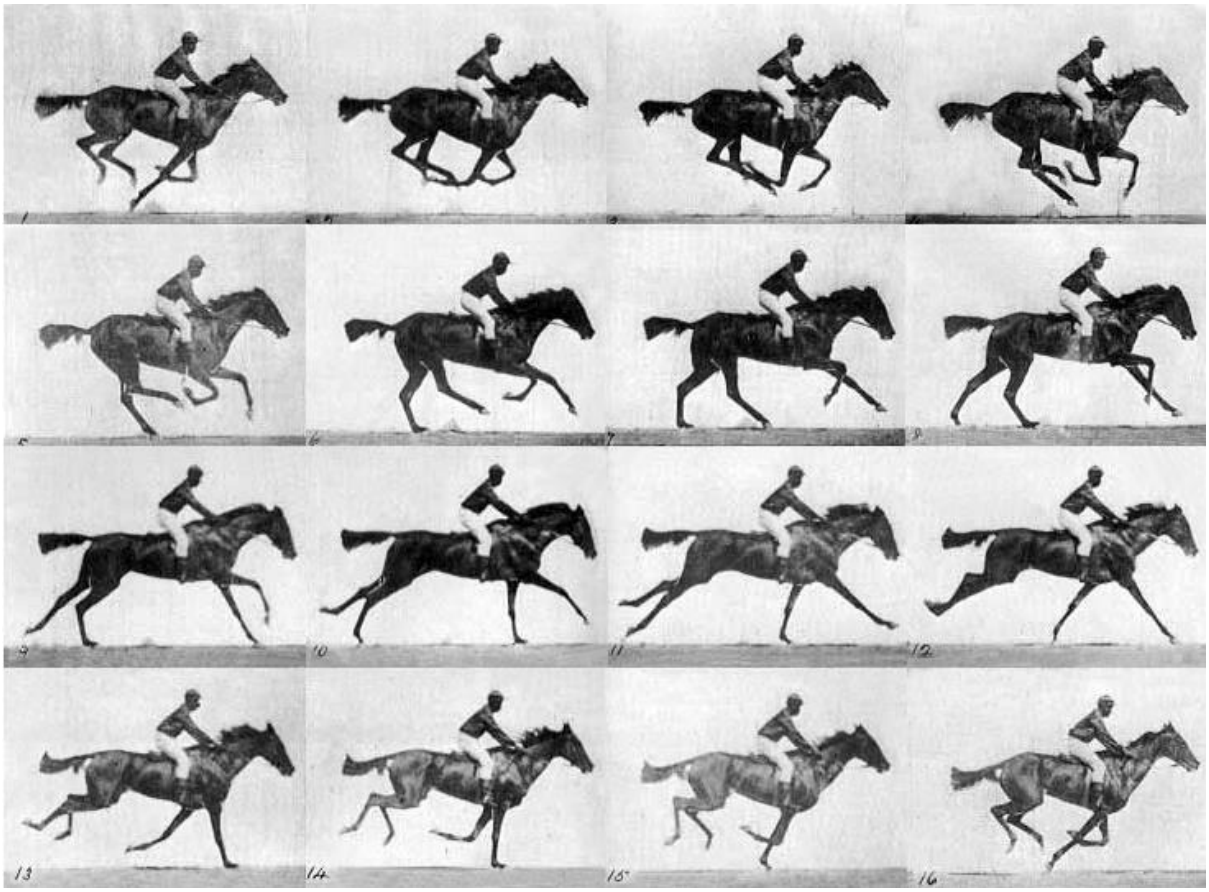


Figure 18: The Horse in Motion (Muybridge, 1878)

6.3. 'The Circle and the Rectangle': Forms of Wholeness and Balance

It is perhaps unsurprising that the current entry of logistical technologies and forms of calculation justifies itself according to the necessity to (re-)connect a fragmented space, given that a similar set of motivations and desires were at the heart of what is usually regarded as the defining period of the London Underground in its modern guise: the era of the early 20th century presided over by the aforementioned Frank Pick. Inheriting a complex mire of privately operated lines, Pick sought to draw out a single, coherent network. Although work was to be done to physically integrate the system, the task was as much a matter of appearances; as much aesthetics as engineering. As Long puts it, "Pick's challenge was not only to knit these different lines into one, coherent, seamlessly communicating

whole but to use new design and new architectural styles to *demonstrate that unity* and utility to passengers who simply wanted to catch a train and know where it was heading" (2011: 72. Emphasis mine). In this simple sentence we already have a central and recurring theme: the need to demonstrate unity and communicate information without causing disruption to the flows of bodies; the need, that is, to prevent circulation and navigation being compromised by cognition.

London Underground's contemporary approach to this requirement consists of two core principles: 'balance' and 'wholeness'. These principles recognise the Underground as a potentially confusing, even frightening, environment characterised by a surfeit of messages, information, and, of course, people, all of which produce or exacerbate both real and perceived risks. As TfL's (2015) *Design Idiom* states, "[g]ood design must be balanced…

> …This is especially important in stations, where there are numerous and often competing sources of stimulation, from ticketing, signage and advertising through to retail. These spaces can be busy, noisy, distracting, confusing and, for some, overwhelming. Through balance a greater sense of order and calm can be brought to stations. The different elements of any type of station space should not compete too strongly with each other or cause unnecessary distractions for customers and staff." (TfL, 2015: 34)

The balance specific to the Underground is an order in which, although many functions, intents, and desires may be present at any one time, these must all be organised such that circulation is not inhibited. This is ensured, initially, by the notion of wholeness as a foundation for design: "Good design", marks the *Idiom*, "starts by considering the whole…any project should take account of the whole station and its position within the network" (TfL, 2015: 68; 70). The whole, moreover, is explicitly a circulating whole. That is, wholeness must be expressed not statically but through movement. It is not adequate therefore that wholeness be marked by rare but grandiose identifying symbols in a small

number of key locations; instead, identification must be continuous and extended throughout. Even in spaces which we might consider insignificant – spaces which, we might say, we are merely 'passing through' – there must be a sense of purpose and reassurance inherent to the design of the environment. In fact, these spaces are the most delicate and vital of all, since the very function of a transport network – in particular, a high-pressure system such as the LU – is to ensure a perpetual 'passing through'.

In the quest for wholeness, TfL's *Idiom* produces an ideal type: the 'ideal station' (Fig. 19). This is a prototype which outlines many of the features to be discussed in the current chapter. First of all, it summarises the components of wholeness, directing designers to "[a]dopt a consistence approach to materials, lighting, retail and advertising throughout the station to make the station feel like a 'whole'" (2015: 21). Secondly, it begins to elaborate upon appropriate applications of these components in particular (albeit interconnected) spaces of the station environment: station exterior; ticket hall; escalators; routeways; concourses; and platforms (ibid.). In view of what will be covered in later sections, it is worth noting two things at this point: first, the emphasis on a range of sensory cues, especially the use of colour and lighting, as well as specific materials. Second, the roles of such cues in helping to strike the balance between advertising, retail, safety and navigation – for example, the identification of ticket halls and concourses as "important decision-making spaces" in which clarity and calm is paramount, and hesitation potentially calamitous, whilst tunnels, escalators, and platforms are earmarked as potentially profitable spaces in which to capture attention through bold features and advertising. As the financial pressures on TfL and London Underground have been intensified, and the perceived risks of the space have taken more unpredictable and dynamic forms, the balancing act has become increasingly contentious, leading, potentially, to acts of exclusion and suppression.

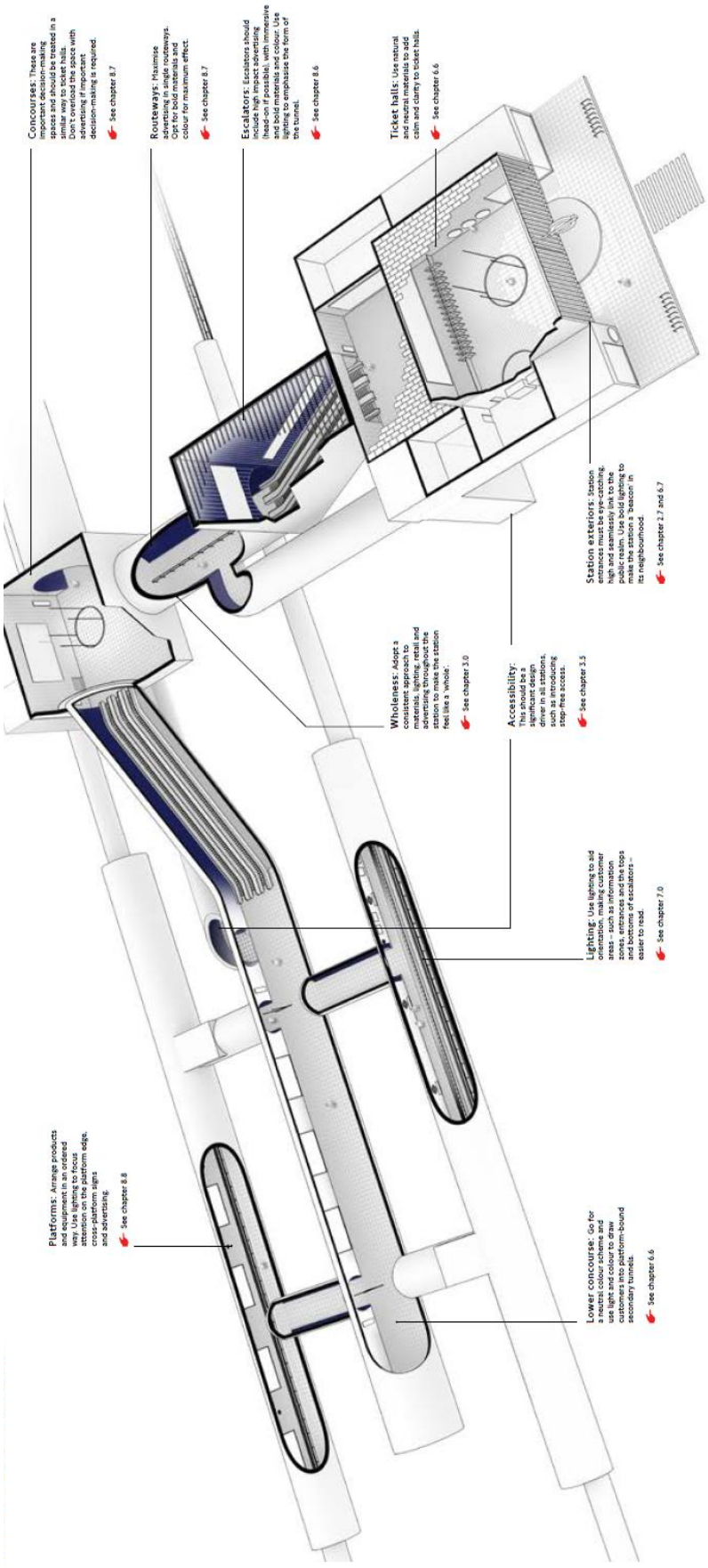


Figure 19: 'The Ideal Station' (source: TfL, 2015: 21)

The prioritisation of circulation within this notion of the whole is represented, simply but powerfully, by the roles of the circle in the design of stations. This begins with the London Underground roundel, a symbol also developed under Pick's influence in the early 20th century. In the contemporary design guidance for the system, the roundel is deconstructed and then broadened to a general principle: "the principle of the circle and rectangle". Whilst the rectangle as a general form indicates "local identity and flexibility", the circle is the symbol of "network consistency" (TfL, 2015: 38). Thus, "[t]he clear relationship between the circle and rectangle creates harmony between the need to express the identity of the Underground network and for stations to be neighbourhood places" (ibid.). In addition to the roundel itself therefore, these two categories of shape are seen to appear in many different guises throughout the network. Rectangles serve to carry the names of stations, and as frames for other locally specific information. Circles, meanwhile, are not only the dominant architectural form of both train and passenger tunnels; they also appear frequently in various station features such as tiling and 'Help Points', as well as in many pieces of Underground art and advertising. TfL's *Idiom* itself highlights this proliferation of circular forms, indicating a purposeful deployment that is both deeply functional and deeply symbolic (Fig. 20).

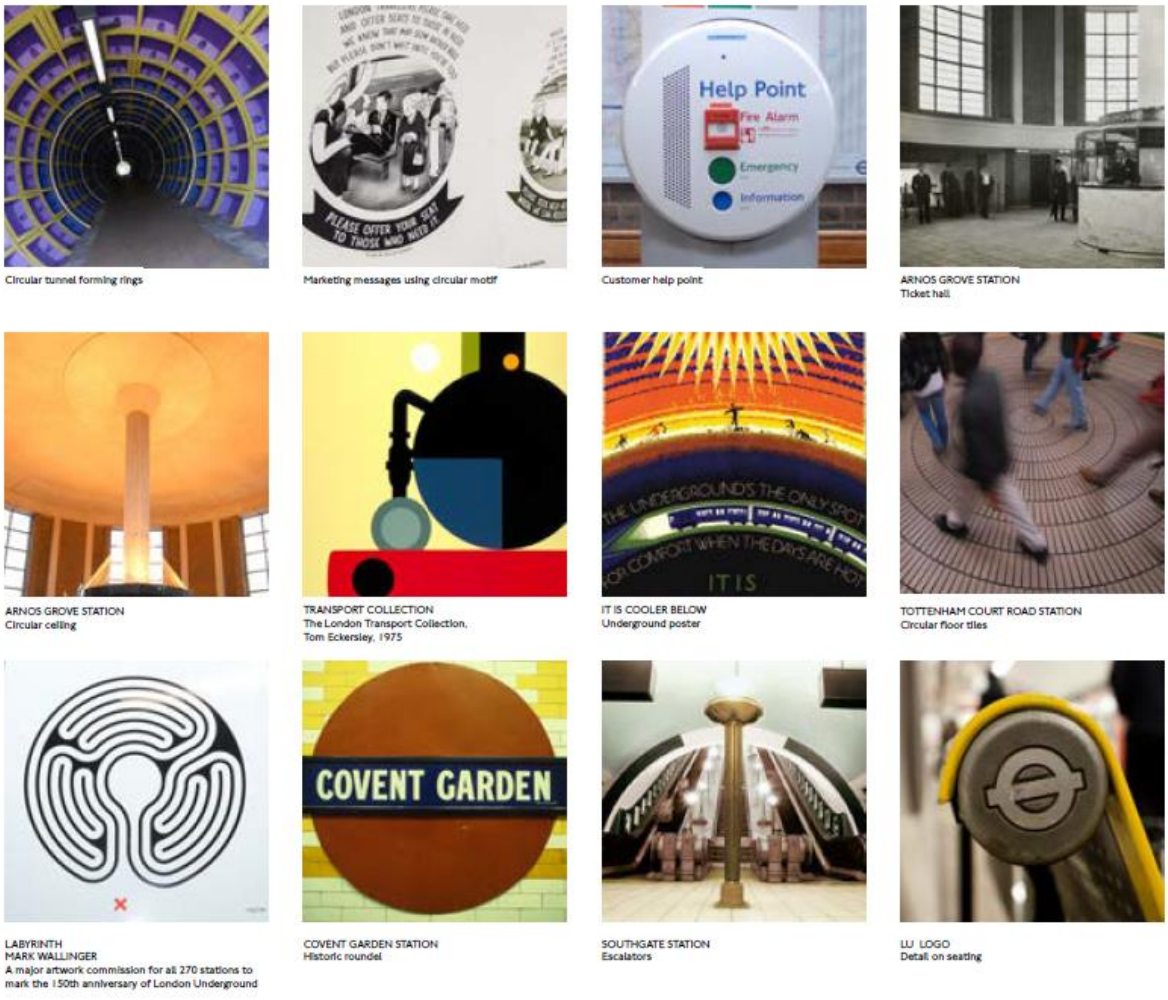


Figure 20: Manifestations of the circle (source: TfL, 2015: 40)

It should be noted, as Exo Adams (2019: 76-7) explains, that the use of the circle as a symbol may be traced back as far as theological representations of God and the universe in Ancient Europe, which posited it as evidence of divine harmony and perfection in Nature. As machinic technologies were developed, moreover, this 'metaphor of the circle' (ibid: 75) came to be applied to manmade objects:

> "the first devices employing circular, rotating parts, and even the wheel itself, were seen as a kind of evidence of a continuity between the patterns of the heavens and the rhythms of human activity" (ibid: 77)

Even as Western societies became increasingly secularised, the metaphor of the circle persisted through reference to the orbital motion upon which the first mechanical clocks in the 14th century were modelled. As Mumford says, "in the effort to arrive at accuracy in [time-keeping], the astronomical exploration of the sky focussed attention further upon the regular, implacable movements of the heavenly bodies through space" (Mumford, 2010 [1934]: 16). Such an allusion to the cosmic attests again to Virilio's idea that locomotion aspired to a space free of obstacles, devoid of matter; a space which is 'natural' but at the same time abstract, measurable, reliable, almost mechanical. And yet it is in the material – often crowded, sometimes uncomfortable – spaces of the Underground which we encounter these idealistic visions.

The prominence of the circle in the design of the Underground, then, carries through to the 20th and 21st centuries a set of ideals present since antiquity. This was facilitated in particular through Pick's decision, upon taking control of the newly-formed London Transport in 1933, to bring the formerly chaotic and uncoordinated farrago of posters and advertising on the network under much closer supervision (Long, 2011: 30). Not only did this add to the visual consistency and legibility of the system by ordering and standardising; Pick also encouraged the artists he commissioned to incorporate elements of the roundel into their works (ibid: 50), thus lining the walls of stations with frequent and varied renderings of circle and rectangle; *localised inferences to the system as a whole*. One of the most famous examples here is Man Ray's 1938 poster *Keeps London Going* (Fig. 21), in which we find the roundel itself in orbit, suspended above Saturn in a strange and ethereal scene (see Long, 2011: 32). This image picks up on that peculiarity of the astronomical as a system composed of circles (or rather, spheres) in *double circulation*, at the same time spinning on their own axes and orbiting the sun.

Figure 21: Keeps London Going (Man Ray, 1938)

The notion of an orbital circulation alludes, at the same time, to one of the central purposes of Underground design: to exert a kind of *pull* on the bodies which circulate within its field; to *draw* passengers through the system via subtle means of encouragement and persuasion. This is where the use of the form of the circle in the system's design is more than *just* symbolic or representational; it also serves direct practical purposes, reassuring passengers of the network's coherence and their whereabouts within it, continually reminding them of the function of the environment, and encouraging onward movement. Like the solar system, in this functionality there is not just one circle but many. According to the vision of the *Design Idiom*, circles of different kinds should form a chain unifying the passenger's path through the system. The imagined process here is of a system of continuous circulation maintained through many smaller circulations which flow into one-another. As such, it is in equal measure naturalistic and mechanical, bearing resemblance to both educational abstractions of the water cycle, and diagrammatic representations of interlocking cog systems (Fig. 22).

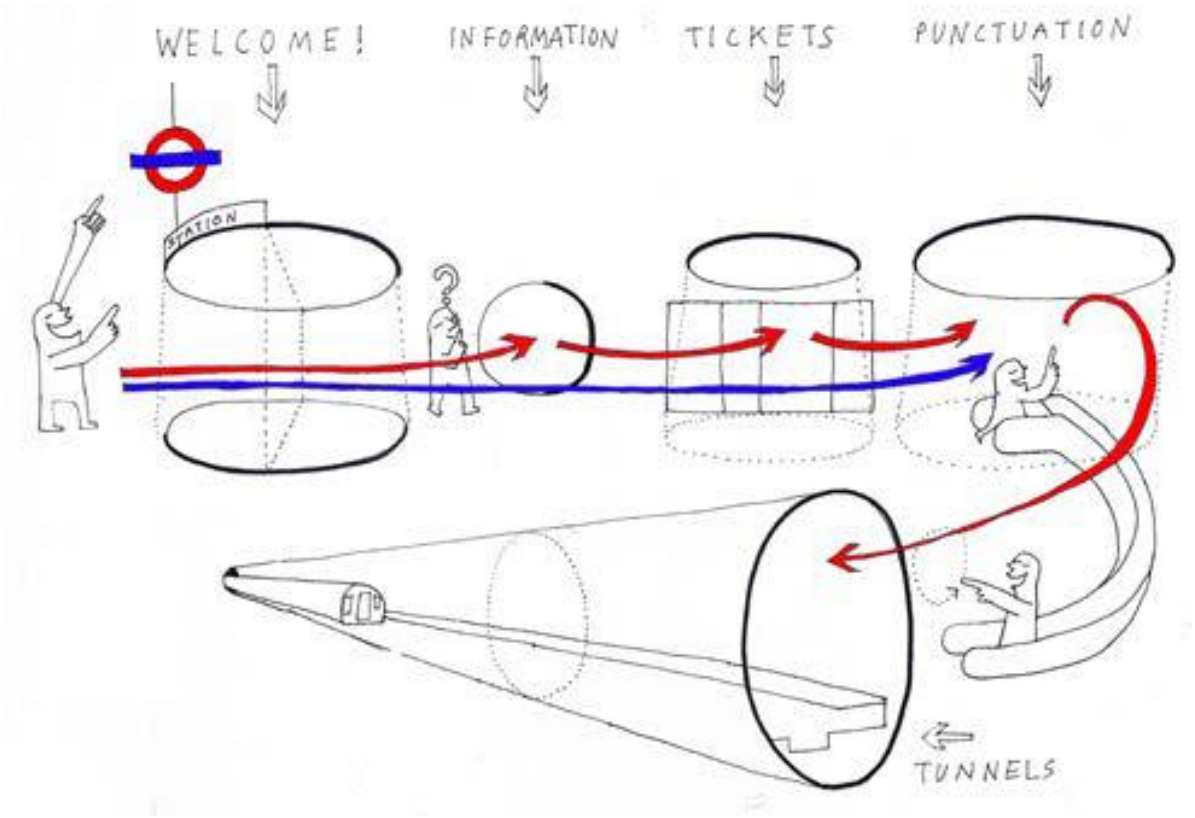


Figure 22: The circle as a trail (source: TfL, 2015: 39)

Despite this mechanistic appearance, the reality is of course far from a deterministic system of levers and pulleys. Design seeks to influence the decisions, and to act on the senses and emotions of passengers. Again, the influence of neotechnic devices is evident here, for whilst the overarching guidance of the *Design Idiom* seeks to create a standardised blueprint, coherence is accomplished also through attention to the details of presentation, light, texture, and sound. The Underground is clearly something more complex than a void in which space has been flattened or annihilated in favour of a logistical strategy of pure speed. Indeed, the concept of balance illustrates how the design of such a system is influenced by a multiplicity of conflicting functions and interests which in turn lead to a series of different orders across different spaces. As the *Idiom* defines it, "[u]nderstanding which element in a given space should be prominent and which should be more recessive achieves visual

balance" (2015: 42). There is, for instance, the imperative to "[b]alance customer information with commercial opportunity" (ibid: 43). Along similar lines, there is an emphasis on integrating stations with their surrounding areas; "However", cautions the *Idiom*, "it is crucial that flagging up local highlights does not disrupt the smooth running of the station" (ibid: 57). Flexibility and locality are thus embraced only so long as they do not distract from the feel and function of wholeness.

These essential principles permeate through a range of finer details. As such, the basic shape of the circle is not the only form drawing passengers through the network. Indeed, far more obvious in this sense is the volume of signage required in such an environment: those arrows and messages which advise and inform us in our decisions on where to move and how to act. As mentioned previously, these sometimes consist of prohibitive notices involving the invocation of a punishment if one violates a given railway bylaw, but, more often, they encourage or discourage, incentivise or disincentivise by calling attention to the negative consequences of certain actions. More relevant at this point in the discussion however is not the exact *content* of such messages but, in the context of the principles outlined above, the sensory forms which they take. The central point is that words, in the way they are deployed on the LU, are often less linguistic than they are geometric – their form, shape and spatiality are as integral to their function as what they actually say.

6.4. Language, Sign, and Form: the Question of Logistical Images

> "[The logistical image is] an image shorn of the subjective, reflective, contemplative features generally ascribed to an artistic representation, as a representation produced for a viewing, judging subject (individual or collective). The logistical image…is to be considered primarily in its informational functionality, as an element in a concatenation of actions, or in a *flow*"
>
> (Toscano & Kinkle, 2015: 208)

The very first poster commissioned by Pick – John Hassall's *No Need to Ask a P'liceman* – was also the first poster to render the word 'Underground' as UNDERGROUND (Long, 2011: 32). Through its bookend letters, this act "helped translate the word into a sort of proto-logo, more eye-catching than descriptive" (ibid: 38). In capitalising the last letter, this word breaks from the confines of not just the English language but language *per se*, and becomes shape or form; a symmetrical form which supplies its own visual frame. It is intended to be read neither left-to-right nor right-to-left but geometrically and with immediacy. Although this particular element of LU branding is no-longer part of the approved style (having been replaced by uniform capitalisation), the underlying logic remains deeply influential. It reflects a broader characteristic of the environment wherein language is *as much spatial as it is discursive*, and as such is intended to communicate its function instantaneously, curtailing the gap between thought and action; signal and response. In this sense, the Underground environment could be likened to the airport terminal, which Doganis (1992: 443. *Quoted in* Ali & Keil, 2010) describes as "an environment that invites an automatic response from the passenger; those who have not been to the airport before intuit their projected path according to their situation". Similarly, the Underground is a space which we navigate, in spite of our possibly extensive familiarity, according to a series of rapid decisions based upon a series of visual cues. We are continually *following signs*, the temporary absence of which would leave us immediately perplexed (*e.g.* Fig. 23).

Figure 23: Sign trail - the line diagram is visible from the routeway, encouraging passengers to make decisions on the move (source: author's photos)

This tendency is typified by two interrelated design features: the typeface specifically designed and patented for use on the Underground by the British calligrapher Edward Johnston, and the carefully regulated use of signage on the network. Like the proto-logo UNDERGROUND, the Johnston sans typeface is distinguished by the clarity and symmetry of its form – its 'O' is perfectly round; its 'M' forms an exact square with its diagonal lines meeting dead centre (Long, 2011: 42). Johnston himself was a pioneering figure of modern British calligraphy, motivated by the mission to rescue the art of writing from what he saw as the over-elaborate and illegible styles which had dominated the previous period. In

Johnston's font, clarity of form took precedence over decoration and embellishment. An environment such as the Underground would be perfectly suited to testing out Johnston's ideals. In its unique time-pressured nature, the Underground requires communication that is direct, immediate, and entirely unambiguous. At the same time however, it must attempt to walk a fine line between calm authority and hostility. Johnston sans is thus designed specifically to convey the Underground's 'tone of voice': firm and clear, but also calm and friendly (TfL, 2002: 5).

The Underground's signage is regulated not only by the *Design Idiom*, but also by a further devoted document: the 2002 *Signs Manual*. This conveys the importance not only of the *form* of language, but also its spatiality and positioning. Much as the circle is deployed in a chain which draws the passenger through the network, systems of signs work as 'progressions' designed to optimise flow and minimise hesitation. The simple idea behind sign progression is that of only supplying the very minimum of information necessary at any given point in the passenger's journey. When we enter a station (the location of which is signalled to us by the roundel) and approach the gateline, the first thing we see is a set of arrows pointing us towards different lines. No other information is given at this point; "[p]latform information is not introduced until a bifurcation point is reached" (TfL, 2002: 77). It is only here that we get a list of possible destinations, arranged vertically below the relevant platform sign. But even now it is warned that "it takes longer to find a single station name on a line diagram than on an abbreviated list…Lists of main destinations are therefore more suitable for use at busy bifurcation points, where the presence of customers studying line diagrams can cause congestion" (ibid: 78). The sign system works on an intentional scarcity of information, on a strictly need-to-know basis.

The design is, in this way, intended to enable mobile decision-making, the marriage of thought and circulation. The sign trail seeks to keep people on the move, and for this it is necessary to negate those bodily agitations which occur as products of doubt, hesitation, anxiety, or confusion. As well as the initial cue to decision-making therefore, signs also serve the vital role of reassurance or confirmation. The *Signs Manual* thus advises that "[f]urther along the sign path, confirmation signs should be used to provide reassurance" (2002: 78), and, more specifically, that: "Platform entrances are key areas of customer anxiety. Arrival at the platform must always be confirmed by appropriate signing, facing customers at or near the entry point" (2002: 85).

There is a sense, therefore, in which, despite the undoubted importance of the Tube Map as a strategic tool – a technology through which passengers can plot their journeys in the abstract and in advance – there is another, more neglected set of mechanisms which are just as important for optimising the network's circulations. Rather than being strategic, these mechanisms have always worked more according to a 'just-in-time', logistical rationale; according to an awareness that strategic knowledge of more than a heavily abstracted, simplified kind is neither practical nor necessarily desirable in terms of minimising doubt and maximising circulation.

Moreover, in a situation of scarce information, its provision and placement can be used to draw passengers towards and away from given areas. The exact spatial positioning of platform signage, for example, is crucial, given that, although placing it directly opposite the platform entrance provides the quickest possible reassurance, it may also have the unintended consequence of causing passengers to bunch around this area. As such, it is advised that platform line diagrams be "[o]ffset from [the] platform entrance to encourage movement along the platform" (TfL, 2015: 26). Despite being one of the only spaces within

the station in which relative stasis is tolerated, the expected waiting time is so minimal – on deep-level lines with aforementioned moving block signalling, this is down to 1 or 2 minutes – that the priority must always be distributing passengers evenly across this thin strip of land such that they are poised for boarding. This is an even more delicate matter in the context of a train pulling into a station, wherein the pressure created by circulation is exacerbated by the excess force of the machinic mount. As the *Signs Manual* points out, the frequency, height, and size of station identification signs on the platform is particularly sensitive: "[w]hen a train draws into a station, there is a very limited amount of time in which to recognise the station name, which is always a cause of customer anxiety" (2002: 90). Such issues do not just concern sight or visibility, but rather the specifically perspectival notion of 'sightlines' associated with a quantitative and locomotive conception of space. In order for circulation to be as smooth as possible, customers need to be able to see information *before* they reach the point of decision or bifurcation. Station identification signs are thus aligned exactly with the bottom window edge of the particular rolling stock (TfL, 2002: 94). More broadly, care must be taken in the positioning of any object on the station such that sightlines are not obscured (Fig. 24).

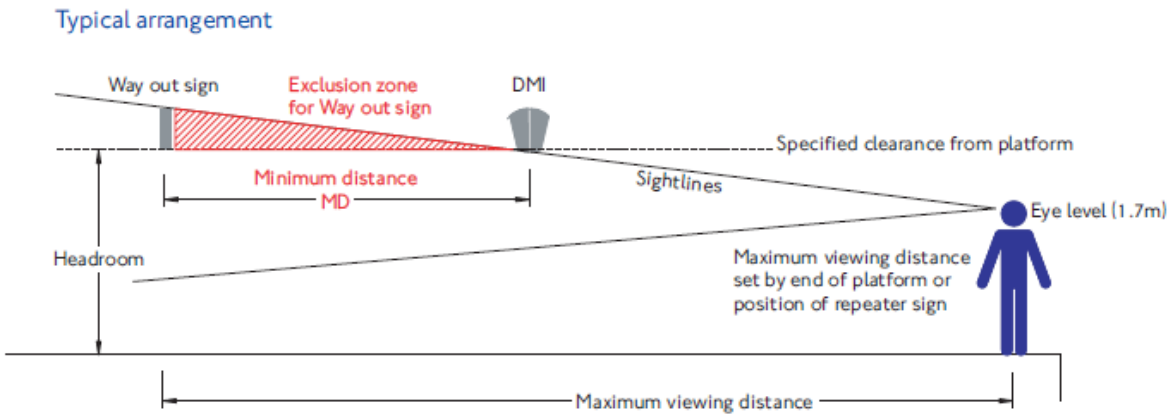


Figure 24: Sightlines (source: TfL, 2002: 115)

As well as positioning signs correctly and with the right amount of detail, form and colour are again vital factors in ensuring both uniformity and legibility such that information is absorbed as quickly as possible. Maps, signs, and line diagrams are more than just images; they are in themselves geometrical designs rendered through exacting calculations and standards (Fig. 25).

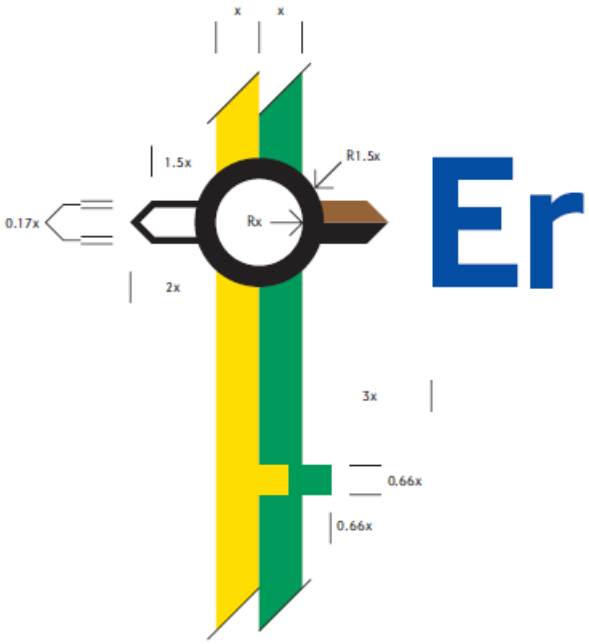


Figure 25: Sign colour and geometry (source: TfL, 2002: 81)

What form of communication is this? Toscano and Kinkle (2015; Toscano, 2018), in their analysis of late-capitalist aesthetics, develop the photographer Allan Sekula's concept of the 'instrumental image' in order to begin a critical discussion of what they call 'logistical images'. They refer here to a modernist phenomenon whereby images initially produced for functional, often military purposes, are removed from the context of their production, commodified, and 'spiritualised' as a form of art. One of the examples they give by way of

illustration is that of aerial reconnaissance photography; images originally "tasked with providing information for immediate use in the tracking and targeting of the enemy", later extracted and curated, made "free to serve as occasions for disinterested visual pleasure" (2015: 209). As the quote at the beginning of this section makes clear, these kinds of images are intended to communicate directly, leaving no room for either prolonged consideration or alternative interpretation. As Sekula says, in the case of aerial photography of cities:

> "interpreting the photograph demanded that it be treated as an ensemble of 'univalent', or indexical, signs – signs that could only carry one meaning, that could point to only one object. Efficiency demanded this illusory certainty" (Sekula, 1975: 28. *Quoted in* Toscano & Kinkle, 2015: 210)

It is in this direct and functional nature of the relation of logistics to space (in particular urban space) that the aesthetic attraction of the logistical image lies. According to this idea, logistics by its nature contains 'lures' which tempt certain forms of representation (Toscano, 2018). Its spaces are characterised by a certain symmetry, and, as we have discussed here, a proliferation of curved forms and seemingly smooth surfaces and flows which give the impression of wholeness, balance, and continuity. This is typified by that emblematic space of logistics, the container port:

> "A rapid glance over the now extensive archive of art about that most compellingly banal of object and devices, the container, suggests that the qualities of *isomorphy, modularity, abstraction, indifference (or anaesthesia), standardization, mathematical or scalar sublimity* that attach to logistical complexes *fascinate* the artistic gaze, drawing into a risky mimesis or replication of the very design and function of the abstract spaces of logistics" (ibid: n.p.)

The image of the railway tracks earlier in this chapter is an apposite example of such a representational temptation, whereby the flattening of the landscape lends to our perspective an unobstructed and sublime view of speed; of smooth extension towards the

vanishing point. Even more evident in the kinds of visual cues which guide passengers around the Underground is the fact that the logistical image "is ultimately not different in kind from other logistical components (charts, material, transport, etc.)" (Toscano, 2018: n.p.). The image, generally conceived as a representation of the network, is in fact part of its operational capacity. Failure to examine the functional attributes of such landscapes leads to complicity in voidal fantasies. As Toscano puts it, "unless we attend to the way in which our artistic and visual practices are responsive to and embedded in capital's *real abstractions* (Toscano, 2008), their constructions of really-abstract spaces, together with bodily and social dispositions, we may be lured into the repetition or reproduction of the very mechanisms we are seeking to depict or dismantle" (2018: n.p.).

As the above analysis of the Underground's use of form suggests, this is a circulatory system which has long functioned upon a range of what we might call logistical images. As mentioned previously however, the Underground is a composite of systems and of sensory devices. The legibility of the space is dependent not only on shapes or signs themselves but on the interplay of signs with the environment as a whole. In this sense, the notion of logistical images, in its exclusive focus on the visual, perhaps excludes the ways in which the aesthetics of logistical capitalism, charged with seeking out ever-greater rates of circulation at ever-lower costs, involve not simply a repression or erasure of non-visual sensory life, but rather its channelling and coordination. Perhaps, considering the range of devices at play, we could speak of a full logistical sensorium. The imperative towards efficiency spurs the necessarily illusory banishment of ambiguity not just in the visual sphere but in all aspects of the environment.

One especially important aspect is the function of lighting, which is applied in a flexible, tailored fashion in order to enhance the feeling of wholeness and circularity, to highlight

important information and spatial features, and to subtly influence passenger movements. The Underground is notable in particular for its heavy dependence upon artificial lighting as a means to creating reassuring, controlled yet adaptable spaces.

6.5. Light without Shadow

> "The motion of the railway, proceeding uniformly and in a straight line, was experienced as abstract, *pure* motion…Analogously, the space of ferro-vitreous architecture appeared as pure and abstract light-space"
>
> (Schivelbusch, 2014 [1977]: 47)
>
> "Lighting should be used in routeways to add interest to an often long and repetitive space. In tunnel spaces use lighting to accentuate the curve of tunnel and create atmosphere. Highlight the start and end points of the routeway and use lighting to give rhythm and definition to the space" (TfL, 2015: 149)

By virtue of its strength and malleability, the use of iron as a building material from the 19th century onwards allowed for much greater expanses of uninterrupted interior space than had been possible with wood and stone, facilitating "the creation of vast new areas to display commodities and to circulate large crowds central to the emergence of new spaces of capital: train stations, department stores, exhibition halls" (Larkin, 2013: 337). In addition, the use of clear glass in such structures allowed, for the first time, for the exterior to permeate through into the interior space. As a result of this architectural shift, "[l]ight and atmosphere were perceived as independent qualities, no longer subject to the rules of the natural world in which they had hitherto manifested themselves" (Schivelbusch, 2014: 48).

The characteristics of this kind of architecture were enhanced further by the use of steel, a key material in the Underground station designs devised by Leslie William Green in the early 20th century. Favouring "a single coherent and flexible design", Green laid Victorian tilework over "strong, easy-to-assemble, structural steel frames of a type which had only

recently arrived from the United States", making possible "the large, uninterrupted internal spaces which were needed for ticket halls and lift shafts" (Long, 2011: 20). Similarly influenced by the use of steel and ferro-concrete in transportation structures in Northern Europe, the station designs of Charles Holden were premised on the desire to renounce ornament and "abandon architecture's traditional 'mantle of deceits: its cornices, pilasters, mouldings'" (Long, 2011: 86; 100-2). This approach may thus be seen as embodying the architectural compliment to what Johnston had sought to achieve in language: the development of a consistent and functional design blueprint that was nonetheless calm and friendly; authoritative without being authoritarian.[13]

The problems Holden had with traditional styles of architecture mirrored those issues that Johnston had with more ornamental styles of writing, namely that, in their over-elaborate nature, they had a tendency to distract the viewer from the function of the message. Heavily stylised architecture in some of the earlier Underground stations was likewise seen as being inhibitive of the passenger's ability to instantaneously read the space. One obvious way in which the novel possibilities of iron, steel and glass could aid legibility and orientation in stations and other spaces of circulation was by opening them up to sunlight. Thus, as Alfred Gotthold Meyer, speaking at the start of the 20th century, put it, ferro-concrete and glass structures lead to "*The reappraisal of light and shadow*" (*quoted in* Schivelbusch, 2014: 46). Light could be let in from all sides, allowing for the creation of all-encompassing 'light-space', to the exclusion of patches of shadow and darkness.

Schivelbusch argues that, with the widespread development of artificial lighting, this function of ferro-vitreous architecture was rendered redundant (2014: 49). In the current context,

[13] That this was a fine line to tread is evidenced by the infamy of one of Holden's most prominent above-ground designs: that of Senate House.

especially in relation to transport infrastructures and their concerns over safety and security, the totality of Schivelbusch's claim is debatable. A number of contemporary documents providing guidance on 'security by design' for stations in the UK – in particular the SIDOS (Security In Design Of Stations) and *Design and Crime* guidance produced by the DfT in 2012 and 2016 respectively – put significant emphasis on the need to maximise natural light in the interests of facilitating surveillance. Just as dynamic risk was, in the documentation on *Complex and Built Environments*, identified as the product of interactions between masses of people, the built environment, and systems interlocking with it, managing risk is viewed here as a matter of cooperation between the design of the space (light), the sensual capacities (specifically, sight) of its human and non-human elements, and its circulatory impetus. Architectural and design choices can, to begin with, influence the efficacy of formal surveillance. For example, it is advised by the Home Office that CCTV is only effective if the quality of the images is sufficient, something which requires, among other things, adequate lighting (2009: 29). There is a preference therefore for buildings, such as train station terminals, to be roofed with large expanses of glazing so as to let in the largest possible quantity of natural light (Home Office, 2009: 57). In addition to aiding CCTV quality, this also "provides an excellent basis for natural surveillance" (ibid.). Adequate light and the openness of space permits police and staff to overlook it more comprehensively, and at the same time encourages passengers to keep an eye upon one-another in an arrangement that is distinctively oligoptic (*see* Otter, 2008).

Figure 26: The roof structure of King's Cross St. Pancras, designed to let in large amounts of natural light (source: author's photo)

One area where Schivelbusch's declaration of redundancy is more accurate is in the windowless tunnels and concourses of the deep-level Tube, and both the *Design Idiom* and the *Signs Manual* discuss in depth the functions of artificial lighting. According to Schivelbusch, the advantages of artificial compared to natural lighting are twofold. First and foremost, artificial lighting is *controllable* (2014: 50). Like the mechanical clock, this means it can be kept at a constant, standardised level across space and time, giving a sense of uniformity even as one moves from one space to another and the light above ground fluctuates or fades. On the other hand, it also means that it is *flexible*; it can be tailored to a particular purpose, can be turned off and on, deployed in varying hue and intensity, and directed into especially selected times and places in order to highlight, inspect, or to create a desired atmosphere. Secondly, artificial light is potentially more *efficient* in terms of its use of space, since it does not require whole surfaces devoted to windows; surfaces which could otherwise be used for information or advertising (ibid.). In this sense, the Underground,

with its entirely enclosed and curved tunnels and trains, is a potentially perfect environment for any kind of visual information – with the exception of the floor upon which one walks, every surface is potentially a viewing surface. Leaving this secondary point aside for the moment, it can be shown that the use of light in a uniform but also flexible manner is a crucial tool for the way in which the Underground environment seeks to influence movement and behaviour around the network. Some aspects of this have to do with the more general properties of light-space discussed by Schivelbusch; others more specifically concern the minute control afforded by artificial lighting, thus combining paleo- and neotechnic tendencies.

Initially, the *Design Idiom* proposes that station designers should "[u]se lighting to create inspiring environments and improve the relationship between architecture, space and people" (TfL, 2015: 103). As such, lighting acts as a mediating agent between the other elements of the environment. This is especially important in spaces densely packed with people on the move. Thus, it follows in the footsteps of ferro-vitreous architecture by facilitating large volumes of flow whilst maintaining visibility and openness. Concourses and ticket halls on a large scale can in this way be filled with light, a crucial precondition for passengers to be able to orientate themselves. With this, a minimum standard is set. However, the *Idiom* is much more ambitious than this, suggesting a large range of functions and effects which might be accomplished through specific degrees and arrangements of light. Rather than a standardised product, light is multiple; it is layered and intensified according to its specific function(s): 'Ambient'; 'Accent'; 'Orientation'; 'Feature' (Fig. 27).

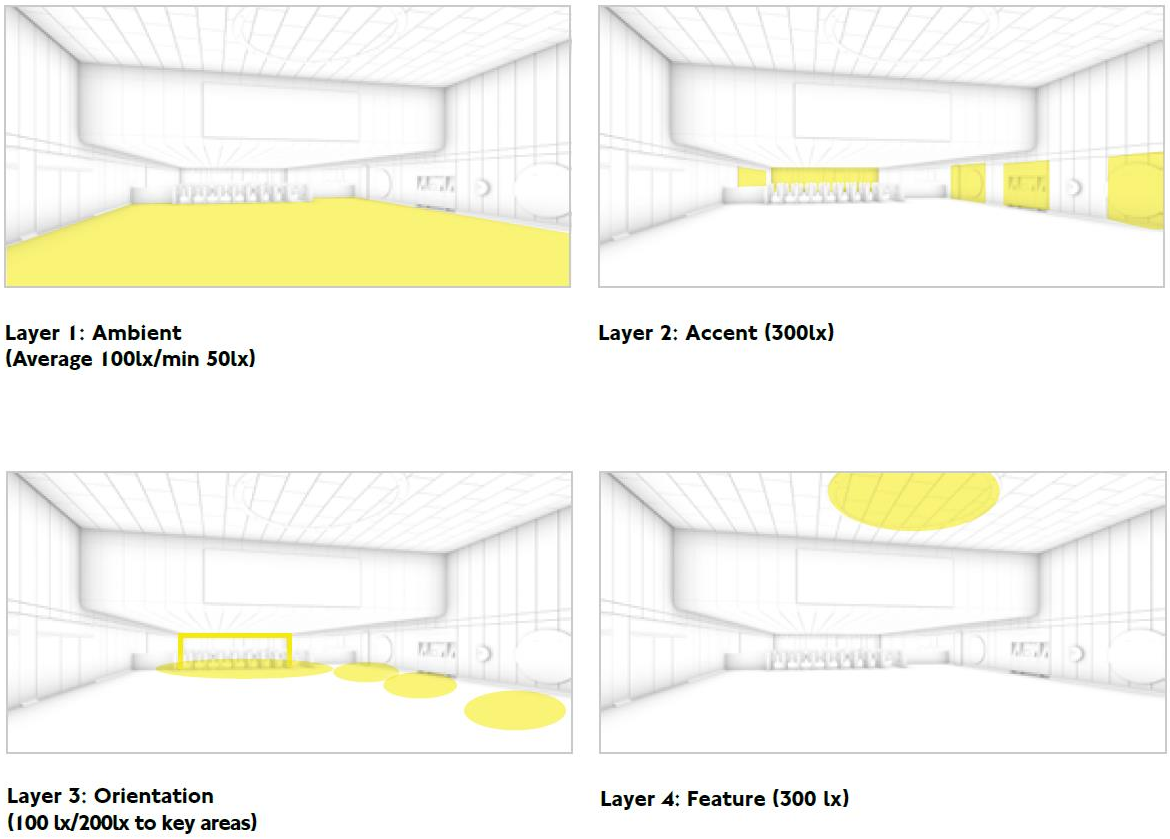


Figure 27: Lighting in layers (source: TfL, 2015: 141-2)

Ambient lighting establishes a standard base level of visibility. Thus, the *Idiom* advises that, in the case of routeways, one should "Apply a base level of illumination to the space and keep lighting levels to a minimum (safe) level. This will maximise energy savings, while allowing the other lighting layers to have maximum impact" (2015: 148). On top of this necessary minimum threshold, light has a number of different functions. 'Accent' lighting consists for example of "Wash[ing] the wall surfaces of tunnels to accentuate their form" (2015: 149). Architecture and form does not exist independently but relies upon other elements such as lighting for its effectiveness. Via this interaction of light and matter, the impression of curvature; of smooth circular form, is enhanced. The third layer, that of 'Orientation' lighting, "[h]ightlight[s] areas at the end of circulation routes into the ticket hall to draw customers onwards" (ibid.). In the specific case of escalators, it is recommended that they

"should be brighter at the top than at the bottom. This change in lighting levels helps the eyes to adapt and aids orientation by creating a 'light at the end of the tunnel' effect" (2015: 154; Fig.s 28 & 29).

Figure 28: Light streams through a circular opening at the top of the escalator at Southwark station (source: author's photo)

Figure 29: Escalator, Jubilee Line (source: author's photo)

In this way, lighting of a controllable kind is a crucial tool for directing and encouraging flows without imposing concrete physical restraints which, in a given situation, may produce or exacerbate risks. Deployed in this way, it is as much a medium of communication as it is an atmospheric quality. As the *Design Idiom* puts it, layers of lighting enable different elements of the environment to be prioritised, thus guiding mobility and optimising circulation:

> "Considered lighting can be used to create a visual hierarchy which can influence customer movement within a station. For example, by ensuring platform exits are clearly highlighted, customers can be encouraged to alight from their train quickly, maintaining and improving reliability by easing congestion" (2015: 156)

As well as what lighting of this kind enables (makes visible), it is important to note what it seeks to exclude. If ferro-concrete and glass had led to the possibility of 'light-space' – light let in from all angles, reducing the incidence of shadows – then artificial lighting on the Underground can be seen to attempt to avoid the occurrence of patches of shadow or darkness without the need for window surfaces. Again, this is achieved through the tight spatial coordination of different design elements. For instance, the *Signs Manual* advises that "[g]reat care should be taken when positioning lighting in relation to signing within all station areas", and, more specifically, that when installing hanging signs, these "should not be fitted close to lighting fittings so as to cast shadows on wall areas" (TfL, 2002: 196). On platforms, tunnels and escalators this is achieved by installing concealed strip lighting at the ceiling edge so as to 'wash down' the walls with light (*e.g.* TfL, 2015: 145). Though shadows are an inevitable by-product of the interaction of light and object, this does not mean that they cannot be washed away by additional sensory arrangements. Light as a 'wash' therefore constitutes another act of cushioning, shining, or smoothing, serving to conceal that friction or blockage of which shadow is the optical symptom.

Although lighting is framed here as a form of communication, it remains almost entirely visual in its function. The following section will look to supplement this analysis with an exploration of how the Underground deploys or regulates other sensory devices; devices of sound and touch in particular. Through this interplay, the Underground governs flows via a mixture of kinaesthetic, synesthetic, and anaesthetic devices – combining senses but at the same time suppressing them to a relatively ordered level, ensuring that they at all times work with, and not against, circulation.

6.6. Kinaesthesia, Synaesthesia, Anaesthesia: the Comfort of Logistics

> "Travelling on the Underground is a sensory experience, punctuated by: the sounds of trains, announcements and chatter; the sense of changing temperatures between spaces; the feeling of different textured surfaces; and a variety of smells"
>
> (TfL, 2015: 102)
>
> "Being 'cheated out of experience' has become the general state, as the synaesthetic system is marshalled to parry technological stimuli in order to protect both the body from the trauma of accident and the psyche from the trauma of perceptual shock. As a result, the system reverses its role. Its goal is to *numb* the organism, to deaden the senses, to repress memory: the cognitive system of synaesthetics has become, rather one of *an*aesthetics"
>
> (Buck-Morss, 1992: 18)
>
> *I take to timing the intervals between the announcements –*
> *13:39…13:55…14:11…14:27 – they repeat every 16 minutes.*
>
> (Research diary excerpt: 29th August, 2018, 13:35, King's Cross St. Pancras)

As the above quotation from the *Design Manual* makes clear, the Underground is far from being emptied of sensory stimulation. Nonetheless, the variety of sensory experiences which do characterise the Underground are increasingly tightly regulated and channelled in the interests of safety, security and (the value of) circulation. In this way, the logistical technics

of which we are speaking seem to repeat, but in a more performative, circulatory and molecular fashion, the slippage between synaesthetics and anaesthetics associated, for Susan Buck-Morss (1992), with modern technology and consciousness. We could liken this, perhaps, to the 'primary levée' identified in chapter five: the burial of the Tube as an attempt to *insulate* circulation from the risks of the city's surface. Yet this techno-utopian quest, as Buck-Morss (1992: 33) goes on to argue, ends up "produc[ing] a counter-need, to use technology as a protective shield against the 'colder order' that it creates". With the attempt to isolate ourselves from risks what is produced is the necessity of ever-more fine-grained and immediate forms of anaesthesia; ways of parrying or, perhaps, managing sensory shocks and frictions.

Mumford (2010 [1934]: 125) notes how, since the development of clear glass as far back as the 14th century, this material had served as "a symbol of the double process of naturalism and abstraction" – letting the organic in but at the same time isolating and rationalising it – and a similar ambiguity surrounds the sensory environment of the Underground. Whilst most of the discussion so far has concentrated on visual qualities, there is also a significant concern over other sensory qualities such as sound, temperature, smell and texture. In the case of temperature for instance, the early posters of Frederick Charles Herrick – another notable use of the circular form – argue that, as a result of its burial, the Underground serves as effective insulation from seasonal variations in temperature (Fig. 30). According to this idea, the Underground moderates what Mumford might call the city's climatic range (ibid.), protecting from extremes of heat in summer, and cold in winter. Such a representation, its contemporary accuracy aside, was intended to project an image of order, insulation, and comfort onto the experience of subterranean travel. Whilst being likened to the cosmic, naturalistic circulation of the earth and the planets, the experience of the Underground was also to be thought of as regulated and civilised.

Figure 30: Frederick Charles Herrick's (1926; 1927) Underground posters

Similarly, in my diary account of King's Cross St. Pancras, what is notable is not Virilio's 'signal saturation' but rather a surprisingly sparse, deliberate and regulated use of sound. This stands for a broader affective regulation which at times supplies and at other times withholds information, which doses information out gradually and on the go, and which increasingly prioritises more subtle sensuality over the visual or linguistic discursive messaging of warnings and announcements (though these of course remain prominent). As opposed to a surfeit of messages, it is about positioning, balance, and timing. It is with similar considerations in mind that the textures of the Underground environment – the look but

also the feel of certain materials – are regulated, seeking to induce in passengers feelings of reassurance, comfort, and control.

As previously mentioned, the design of architecture and lighting on the Underground seeks to deploy and accentuate circularity and curvature as a way of encouraging onward movement and reassuring passengers as to the wholeness of the network. While in this context the mechanism may be primarily visual, in a more specific security role curves and slopes serve a particular function derived from their texture; their tactility (or lack thereof). Thus the SIDOS document states that:

> "Curved or sloping tops on ticket machines, advertising panels and vending machines make it difficult to place items on them and are strongly recommended. Flat-topped structures should not be used. Fitting them back-to back with other machines, or on legs with large gaps underneath, can also make it difficult for someone to attempt to conceal an item without it looking obvious. Making window sills slope is also recommended" (DfT, 2012: 23)

This paragraph reveals an intent to minimise the occurrence of flat surfaces, that is, *surfaces capable of holding or supporting other objects*. Surfaces in this sense are rendered a locus of risk on two counts: firstly, because they may become the supporting platforms for dangerous items, and, secondly, because, *as surfaces*, it is in their nature to carry an *underside or interior*. As Jean-Luc Nancy has it, this is the inconvenient truth of three-dimensionality: that the creation of an image, of the visible, is "inseparable from a hidden surface, from which it cannot, as it were, be peeled away: the dark side of the picture, its underside or backside" (Nancy, 2005: 2. *Quoted in* Bishop, 2011: 276). Since they cannot be peeled away from that which creates them, these withins, behinds and underneaths of space are secured by designing in surveillance of, and designing out access to them. Smoothness, slope and curvature are thus both an affective cue to onward movement within the

circulatory whole, and, moreover, a psychologically reassuring set of textures which hope to erase hesitation, doubt, and fear by reducing the potentiality inherent to surfaces. Particularly troubling in this context is the lurking presence of shadowy recesses; the potentiality of darkness (see Agamben, 1999: 179-81). Thus, as with the positioning of hanging signage mentioned earlier, any article of furniture installed on a station must be considered carefully for its potential to produce concealed surface. For example:

> "if planters are to be used on a station, they should be designed so as to make it impossible to hide anything underneath, i.e. with either no gap or a gap so big that anything can be visible from all sides. Planting should not be so dense that it hinders searches." (DfT, 2012: 23)

This function is not restricted to smoothness. The DfT's *Design & Crime* guidelines also endorses as good practice in station landscaping the "use of prickly shrubs to minimise opportunities for concealment" (2016: 4). In the same way that sloped surfaces prevent things from being placed upon them, prickly exteriors prevent access by being anti-tactile. Whilst *looking* soft, perhaps even aesthetically pleasing, these surfaces provide a tactile hostility to space. Once more, this works through a particularly neotechnic trait, mobilising organic forms as a way of increasing both the visual attraction and the operational efficiency of space.

This in turn links to a broader design theme, whereby certain sensory elements of 'nature' are introduced into the Underground space. The *Idiom* for example devotes a subsection to 'Promoting a sense of nature', in which it suggests adding green walls, introducing birdsong or the sound of a gentle breeze, or engraving natural patterns into concrete walls (TfL, 2015: 101). With regards to the use of lighting, it encourages using "as much natural light as possible", but, where this is not possible, it also proposes that designers "[s]uggest a connection to the natural world using artificial light. Soft shafts of light from above, with a

similar colour temperature to sunlight (or moonlight), can mimic the effects of natural light" (ibid.). This is, of course, a kind of reintroduction, wherein the organic makes a return into the space from which it was previously exiled, only in a rationalised and controllable form.

With its emphasis on reassurance, these mechanisms together are intended to give passengers a greater sense of control and order, of ontological security, thus minimising the tendency to doubt and hesitate. For Virilio, such a feeling of control is integral to the way in which the transport revolution has unfolded. The transport revolution is, in this sense, a series of successive distancings of the body-in-motion from the sensory evidences of its movements. This set of compensatory innovations; the offsetting of various frictions, is at least as fundamental as the size of engines or the vehicles themselves:

> "It is from Britannic insularity that this demand came to us, new for the Continent, of comfort in travelling. This Anglo-Saxon ideology of 'well-being' is encountered in both the bourgeois furnishings [mobilier] of the eighteenth century and in what was first maritime mobility and then rail mobility, the comforted body of the traveller comes to complement the assisted body, the sedentary." (Virilio, 2005a [1984]: 54)

The smoothing out of the route intends to permit the luxury of looking ahead, towards the destination. For Virilio, this is associated with 'dromoscopy'; with the sense of control afforded by the vehicle dashboard. But, for passengers navigating the Underground, this same feeling is applicable to the forward tilt of their own bodies; the dashboard here provided by the stream of logistical images arriving, perpetually, into one's visual frame, together with the multi-sensory play of light, colour, temperature, sound and texture that seeks to draw us onwards. Virilio goes as far as to claim that "the addiction to comfort leads us to lose our sense of touch, the muscular contact with materials and volumes giving way instead to a series of caresses, light strokes, and fleeting slidings" (ibid: 55). Following this line of argument, the way in which sensory interactions are hoped to be ordered,

regulated and softened in the Underground space might be read as lending to that environment a sense of immediacy and thoughlessness; a space of reflex as opposed to contemplation. If so however, this is more complicated than a merely tactical plain in which all actions are considered in isolation from one-another. On the contrary, each small and instantaneous act is linked to many others via chains and progressions, and are sutured in their logic and justification to a strategic outlook upon the vitality of the system. It is also vital to emphasise that, both as an arrangement of cues and directions intended to be recognised and followed with immediacy, and as a way of thinking which prioritises the risks and interests of the space conceived as a system or network, this form of governance inevitably produces a series of exclusionary and marginalising moments. Although it is not the task of the current project to interrogate these moments in detail, it can be noted, for instance, that the logistical perspective is much more urgent in its treatment of those risks which are seen to effect the network as a whole, leading potentially to the backgrounding of incidents, such as sexually or racially motivated crimes, which are prevalent on the Underground but which would not necessarily be heavily disruptive to the system of circulation as a whole. In this and many other ways, logistical power continually fails, yet this does not mean that it is not effective or convincing.

Furthermore however, the uses – as well as the corresponding exclusions and failures – of the mechanisms described above are not exclusively reserved for facilitating or securing circulation. As the next section explains, aesthetic and affective cues also play a significant role in advertising on the Underground, and thus in the extraction of value from the midst of circulation.

6.7. The Commercial Aesthetics of Logistics: Advertising on the Underground

> "London Underground is a unique environment…[w]ith nearly five million passenger journeys made daily on this bustling network, consumer's interactions with advertising in this setting must also be viewed in a different way from other marketing channels"
>
> (Nicola Barrett, Exterion Media research manager, 2016)

In the previous chapter it was proposed that the role of logistical power in the governance of the LU involved a duality of risk- and value-focused objectives. The same technologies, knowledges, and practices being proposed as means of making the system more resilient were also being realised as potential tools for extracting added revenues. While this was previously discussed primarily in relation to data-led devices such as passenger WiFi, analysis in the current chapter has shifted the focus towards the role of space, aesthetics and affect. What becomes evident in this context is the mimicry by advertising of those same aesthetic and affective mechanisms deployed in the governance of circulation and risk.

The relationship between advertising and (systems of) circulation is by no means novel. In fact, it lies at the foundations of the industry of 'outdoor' or 'out of home' (OOH) advertising. No-sooner had the first double-decker buses begun to circulate around London in the 19th century for instance, had the idea been conceived to place advertising hoardings on the upper-deck 'modesty boards' first installed to veil the legs of female passengers (Horne, 2003). As mentioned earlier in the chapter, the Underground, with its abundance of viewing surfaces, is especially well-suited to this kind of opportunism, and, as Horne (ibid.) notes, the 20th century development of the deep-level Underground lines – which, unlike the cut-and-cover system, ran in single-bore tunnels – created an extra passenger-facing wall onto which messages could be pasted. The contemporary significance of such commercial

messaging to London's transportation network (and vice versa) is illustrated by the fact that, as of 2018, 40% of the UK's outdoor advertising by value was owned by TfL (TfL, 2018b: 9).

However, it is not just the availability of surfaces that matters. For Cronin (2008), the OOH advertising industry has developed a growing interest in mobility; in knowing and constituting potential customers and spaces as 'mobile targets'. In particular, the research carried out by these companies frames movement as *attention* or 'mobile reception' (ibid: 106-7). This framing in turn influences the style, content, and form of advertising, formulating a 'commercial aesthetics of mobility' (ibid: 103). In a similar sense, the tensions between attention and circulation in the LU environment demand that advertisements as well as artwork take a specific form. Like the aforementioned systems of signage, they are made to be 'directional' in nature, arranged into 'chains'. It is rare, for instance, for only one instance of a particular advert to be encountered over the course of a journey. As Tamsin Dillon, then head of art on the Underground, observed in an interview with Janet Harbord published in 2013:

> "I have learnt that, particularly in the Tube environment, people really respond if they see something more than once and more than one place. Certainly companies that advertise on the Tube have understood that. What they'll do is place an advert for something on an escalator…then another advert for the same thing with the same message in a different place in the station. So people follow a trail of adverts that reinforce the message" (Harbord & Dillon, 2013: 185).

Adverts are designed to 'stay with us' in more ways than one. The mobility is twofold. The experience becomes one of presences that "move alongside us as our uncanny doubles; images (and words) travel with the rhythmic movement of bodies, cars, trains and goods circulating through the vectors of a city" (Harbord & Dillon, 2013: 178). As well as serving to maximise the effectiveness of the images themselves, regular repetition along the route

avoids the temptation to stop and stare; to sacrifice onward movement for the inefficiency and potential danger of static contemplation.

Figure 31: Chain Advertising - The Advertisement is repeated along an entire tunnel section, whilst the message similarly plays on the spatial form (source: author photo)

The aesthetics established here is, I would argue, not *just* a commercial aesthetics of mobility. It is in fact a commercial aesthetics specific to the logistical, 'just-in-time' character of attention on the LU, and it functions by mimicking or playing on the affective cues of the Underground's own circulatory governance. Beyond the broad use of the chain, advertising on the LU experiments with other aspects of form. In Figure 32 below, a poster for the travel agency Expedia devised by Global Outdoor not only echoes the image of the train

(into which it inserts its escape); it also deploys a variant of the Johnston sans typeface to draw attention to its tagline.

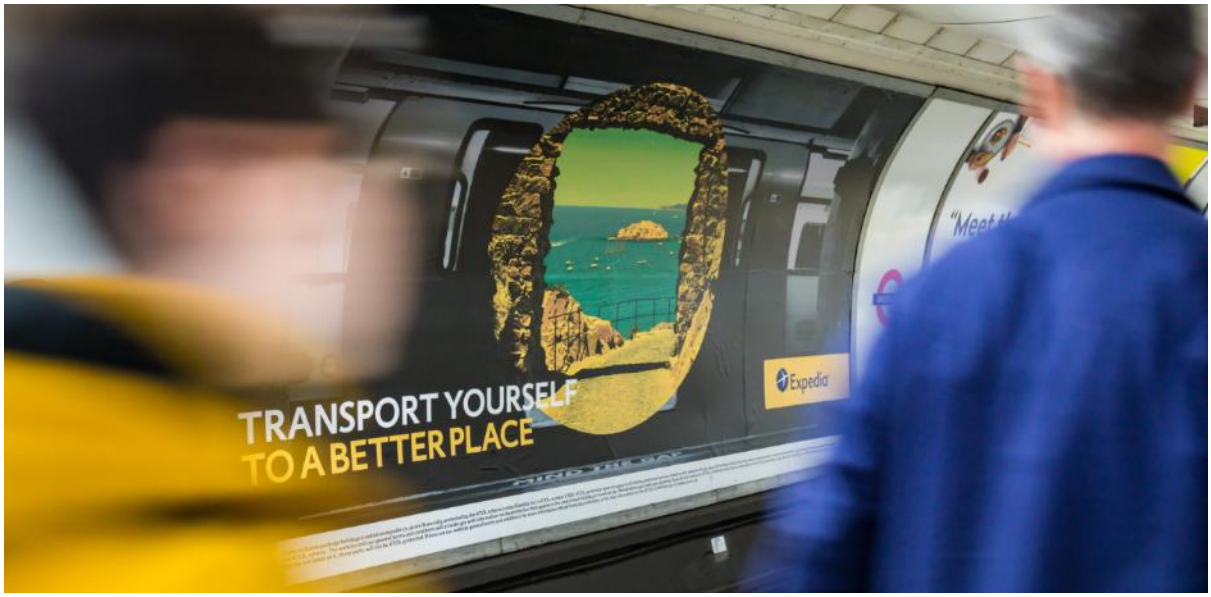


Figure 32: An advert for the travel booking company Expedia, with Johnston sans font

In their immediacy and uses of form, these mechanisms beg comparison with Massumi's (2005) 'affective modulation'. The comparison is reinforced by neuroscientific studies such as that carried out by Global Outdoor in its former guise, Exterion Media, in 2016. *The Engagement Zone* used methods including eye-tracking and skin conductance response to monitor how passengers interacted – both consciously, and in a more bodily, sensory manner – with advertising on the Underground (Exterion Media, 2016). In line with Cronin's analysis, the study focuses on forms of mobile attention. Notably, it marks out Underground passengers as a uniquely attentive market. Given the points made in this chapter thus far, we might relate this to something that exceeds the commercial context, having to do with a broader 'affective tone' (Massumi, 2005) of mobile attentiveness, passengers on the go and on the lookout.

Among the study's top findings was that a higher proportion of the Underground passenger market desired advertising than any other audience (including TV, magazines, radio, online, social media, and apps). This was identified as a motivation "to engage with advertising for its own sake, regardless of whether the product category was immediately relevant to them" (Barrett, 2016). Rather than hailing specific subject positions therefore, this environment embraces advertising for advertising's sake. Advertisements are desired and engaged with in a way that is almost 'pre-subjective' (Massumi, 2005). The function of the advert, we might then say, is most fundamentally as form itself, as an aesthetic and affective mechanism, irrelevant of discursive content. Adverts, together with 'official' LU signage, form chains of iterative, circulatory reassurance, maintaining a feeling of security and calm.

In the concluding section, the exact nature of such logistical mechanisms will be examined in greater detail, with the argument being that they involve more iterative and immediate forms of abstraction than strategic or systems perspectives. This has already been applied to some extent to the spatial – and the idea of logistical images will be fleshed out more below – but it will now be applied to the temporal, as we turn from the predominance of the schedule to that of the countdown: an experience of abstract time that is reliant on a constant updating, a stream of notification.

It will additionally be claimed that an understanding of the mechanisms discussed here effectively grounds the recent desire for 'smart', digitised forms of communication in a broader frame of logistical governance. Far from escaping the physicality of the environment, 'real-time' remains deeply dependent upon its layout; its spatiality; its arrangement of sensory cues. The notion that code functions silently in the 'background' – enhancing the capacities of our real spaces without altering their physical makeup; without making them look or feel different – is seriously challenged by this realisation. The case for the socio-

political significance of this standpoint will be made via a small example: that of busking on the London Underground.

6.8. Conclusions – From the Schedule to the Countdown: the Time-Space of Logistics

The temporal rhythms of liberal urbanites continue to be heavily informed by the quantitative, abstract measure of the schedule described by Mumford and Schivelbusch. Especially when travelling by train, journeys are arranged according to the need to get a certain train at a certain time; checking the small dot-print on the ticket; checking we're getting on the 'right' train; 'our' train. Standing on an Underground platform, however, time is ever-present not in the form of the schedule but rather the *countdown clock*. Rather than orientating our bodies to a given time, time, as it were, *comes to us*. This sensation echoes the broader myopia of urban mobilities in particular; the train only arrives. What we are waiting for is not the train but the evaporation of time to its zero-level, to the momentous transition of the number 1 into the word, 'due'. Our wait is over. What this indicates is a certain flexibility which, as this chapter has argued, is not purely discursive or subjective, but instead becomes manifest in the immediate environment of the passenger, in their experiences of time and space.

This set of ideas links back to the previous chapter, in which it was proposed that the Underground environment necessitated something other than the static, strategic perspective towards risk. Due to the presence of dynamic risks, the highly-pressurised circulatory function of the system, and the financial constraints on TfL and related organisations, managing agencies are increasingly opting for a scalable approach based on rapid communication between tactical and strategic levels of control. Whilst this model seeks an unprecedented 'real-time' velocity through so-called 'smart' technologies, it is nonetheless in the physical design of the Underground environment that we find the germ of

this rationality. Indeed, one of the objectives of this chapter has been to highlight that, although logistics may at the present moment be heavily intertwined with digitisation and 'smart' technologies, these mechanisms are far from the only expression of logistical power. In fact, logistical power is premised, we might say, upon the speed of translation between material space and its abstraction, such that one is always present within the other. Logistical governance in this way sets up in a similar way to how Toscano and Kinkle (2015) imagine '*the aesthetics of the economy*': it works neither exclusively through surveillance of a totality, nor merely as a series of oligoptic fragments. Instead, its power lies in communication between fragment and totality; between embeddedness and abstraction. As will be returned to in chapter seven, where the use of more recent technological developments comes in is making this process of communication gradually more rapid and automated, thus permitting flexibility on a finer scale.

As was noted in the conclusion of chapter five, a particular category of sign common to the Underground cautions against a range of behaviours by invoking 'delay' and a sense of strategic responsibility. However, I have claimed that to reduce such signs to a discourse of responsibility, self-conduct and strategy is to ignore the situational character of those and other signs, images, and technics that attempt to influence and regulate our movements and behaviours around the network, from one moment to the next. Seen otherwise, the kinds of signs and messages deployed in the design of the Underground are in fact of a tactical and operational kind – they are direct, functional, instructional; they gesture with immediacy towards a specific action; a specific bodily movement to be undertaken. The crucial procedure, as I have argued here, oscillates between these two perspectives, functioning via logistical mechanisms which are spatial and situational, whilst also evoking the circulatory whole by (an)aesthetic and affective means.

The iterative nature of such mechanisms allows for a range of messages to be conveyed in a flexible manner. Relative to our previous discussion of logistics, these are importantly not just safety messages – messages related to avoiding or averting dynamic risks – but in fact hybridise the imperative to keep moving with other kinds of message, including advertising. Rather than being a singular process of course, struggles over the regulation and ordering of sensory stimuli on the Underground are in many cases ongoing. One interesting example of how both the negative (risk-minimising) and positive (revenue-maximising) faces of logistical power have been inscribed into the Underground space is that of busking.

The Socio-Political Consequences of Logistical Power: the Case of Busking

As the *Independent* reported in June 1994, from a managerial perspective, busking on the Underground was considered an unacceptable safety hazard, "drown[ing] out emergency announcements and caus[ing] crowds to form in confined spaces" (Mosely, 1994). The decision to legalise and regulate the presence of busking was taken in 2003, at which point it became necessary for anyone wishing to perform in Underground stations to audition and obtain a license. Moreover, from this moment onwards performances would be limited to a number of specially assigned 'stages' across a number of stations – marked, not by any kind of potentially obstructive platform, but by the painting of the floor. Further to a process of regulation, this was also one of commercialisation: the initial 16-week trial period of the scheme, for instance, was sponsored by Carling for £600,000 (Chrisafis, 2003). This had consequences for the buskers themselves, with a number of complaints at the time that branding led passers-by to mistake them for paid performers, resulting in smaller donations (ibid.). Whilst the introduction of stages meant authorities could decide on the safest locations, busking remained in tension with the mitigation of risks and disruptions. As a consequence, buskers are bound by a peculiar condition: "There are rules about how entertaining [the buskers] can be: if a crowd forms, they must stop playing and let it

disperse" (ibid.). This expresses nicely the tension of such a space: that forms of entertainment and stimulation are welcomed, so long as they do not obstruct functionality and flow.

Yet more recently however, tensions have been revealed between busking and other, more lucrative stimuli. Following the establishment of digital advertising hoardings on the network as a means (in the context of TfL's aforementioned financial pressures) of supplementing the system's revenue, in January 2019 a company paying for advertising on one hoarding behind a busking spot at Leicester Square station complained that the buskers were distracting customers' attention from their own message. This resulted in the temporary banning of busking from the station, until a petition submitted to the Mayor's Office gained over 2,000 signatures and eventually succeeded in ensuring its reinstatement (Change.org, 2019). However, the location of the busking spot itself was moved off to the side, to a less prominent position where it would no-longer prove a distraction. The need to do more with less therefore leads to the subtle commercialisation and marginalisation of certain behaviours to the advantage of more lucrative uses of space. In gradual and incremental ways, this can have significant long-term consequences for the question of what (and who) public infrastructure is for. For instance, in the marginalisation of something like busking, the conception of infrastructure as a multi-sensory urban experience is further suppressed and replaced by a rationalised, scopophilic domain of efficiency and commercial value. This is a set of ideas we will return to in chapter seven in the context of the politics of urban infrastructures more broadly.

In the next and final chapter I will come to argue that any form of resistance to logistical power requires something other than attention to moments of friction or disruption (broadly conceived). Rather, what is needed is an appreciation of and attention to the

possibilities of infrastructure outside logistical coordinates, as that which enables a sensory and cognitive witnessing of the urban; that is, as a form of sociality rather than a means of transporting, securing, and producing value. Moreover, in attempting to realise such alternatives, it is necessary to not only counter (strategic) representations with tactical agitations, but to intervene within the logistical itself.

7. Conclusions: The Underground, the City, and Logistical Power

Foreword – Chapter Recap

So far this study has examined a number of distinct strands of literature and empirical work, and set out a range of arguments. These are worth recapping here so as to tie them together and to act as a point of departure for the concluding chapter.

Beginning with the oft-cited idea that urban governance in the post-industrial 'Global North' has turned to a 'resilience' approach in attempting to deal with an unprecedented degree of technical complexity and unpredictability, the literature review (*chapter one*) built upon the claim that, rather than representing an abandonment of governance to contingency, this framing of the world has in fact given rise to novel forms of knowledge and practice intended specifically to enable action despite radical uncertainty.

The chapter took as a central concept Collier and Lakoff's (2008; 2015) Foucauldian notion of 'Vital Systems Security' (VSS) – the idea that contemporary liberal governance holds, as a key responsibility, the protection of those infrastructures crucial to sustaining modern life, but susceptible to potentially catastrophic failures as a result of their complexity and interdependence. In particular, VSS enabled us to assert that, rather than a specific capacity which becomes necessary in light of novel, uniquely unpredictable kinds of threat associated with terrorism or 'late-modern' technologies, the current 'resilience turn' is embedded in broader forms of governmentality. The chapter argued therefore that the need to manage radical uncertainty has always been a prime concern for liberal rule, especially in an urban context. Although it is now manifest in attempts to govern the techn(olog)ical complexity of systems, it has its precursors in attempts to govern the socio-political and spatial complexity

of urban populations, and the ever-present possibility of unrest and sedition inherent to them.

VSS is based upon a particular form of knowledge, 'system-vulnerability thinking', which attempts to model or enact the effects of potential emergencies. In this sense it corresponds to an 'all-hazards' approach, wherein resilience is achieved by building generalised preparedness for responding to and recovering from any conceivable event. As others have noted however, the recent work of emergency bodies such as the UK Civil Contingencies Secretariat is based upon the need to act upon the 'within' of the event, intervening in its evolution and curtailing or diverting its spread. Consequently, the chapter shifted attention towards the specific capability of 'rapid response', which puts an emphasis on speed, going out to meet the event in its emergence.

Given the importance of anticipatory and real-time forms of monitoring to rapid response approaches, the growing prominence of such techniques has been linked to the use of ICTs and 'smart' technologies in the management of urban flows, a set of developments criticised by certain observers as driving the 'corporatisation of city governance'. Whilst I argued that these important patterns must be taken into account, there was also recognition here of the need to avoid reducing circulatory governance to neoliberalism. As such, the chapter concluded by asking whether we might need to diversify our theorisations of governance in liberal urbanities to account both for the idea of securing circulations against potentially catastrophic risk-events, and for the influence of a corporate rationale functioning according to principles of cost-minimisation and profit-maximisation.

As a way of conceptualising the tense coexistence of the resilient and the smart, risk and value, I turned in chapter two to a third literature, that of logistics. Logistics, I argued, has the potential to help us encapsulate the duality of aim involved in circulatory governance,

but only if we take into account both its military origins, and the ways in which, over the course of the late 20th century, it has shaped, and been shaped by, its work in the corporate sphere. Within this sphere the so called 'logistics revolution' involved both the idea of resilience to frictions and disruptions which might threaten the smooth flow of capital, and the more positive notion that circulatory vectors represent previously unexploited frontiers for the extraction of value. In addition, I drew attention to recent writing on logistics that emphasises the material, aesthetic and affective properties of circulations and the roles they play in both attempts to maintain the order of circulation, and attempts to disrupt this order as a means to amplifying political claims. I concluded the chapter therefore by tentatively posing an augmentation to Collier and Lakoff's framework based around a logistical form of power that is more multi-faceted and potentially more wide-ranging than VSS.

In order to explore these theoretical issues, I carried out an in-depth case study of the London Underground metropolitan railway system. This case was chosen for a number of reasons which were discussed in detail in *chapter three*.

In *chapter four*, I outlined my methodology and method, arguing that the theoretical framework of logistics – as a form of power that oscillates between strategy and tactics – necessitates an approach that studies neither only discursive regimes and ideological complexes, nor only small-scale interactions, but rather focuses on the interactivity between these two levels of analysis.

In the first empirical chapter (*chapter five*) the LU was positioned within broader conceptions of urban risk. Here it was argued that the Underground, due to the *social and spatial complexity* of its environment – characterised by density and enclosure, but also openness and a transitory populace – poses special difficulties for governance. Risk, in the Underground, is not only potentially catastrophic but also *dynamic*: mundane, regularly

occurring events can, quickly and with little warning, transform into far more serious incidents if not monitored and intervened in with adequate speed. At the same time, the Underground is operated by a public organisation which, like many others, is currently under intense financial pressures. In this context, the previous prominence of multi-agency exercising and enactment as an approach to uncertainty appears to be receding in favour of an approach that attempts to integrate the potential emergency into everyday operations via the principle of 'scalable' response. This is enabled, I argued, by the growing influence of logistical technologies and expertise which promise both to enhance the resilience of the system, and, at the same time, to contribute to operational efficiencies and generate additional revenue. Crucially, scalability and digitisation enrol the passenger to a growing degree in the exercise of circulatory governance, with WiFi access and open data enabling acts of re-planning and risk aversion, as well as value production and consumption to be carried out dynamically, on the move.

Evident here is a form of governance that functions through operations of feedback between the strategic and tactical levels. Growing degrees of centralisation are coexistent with a pattern of dispersal. Passengers are not only enrolled through digital means however, but also through their immediate environment. In the second empirical chapter (*chapter six*) therefore, greater emphasis was placed upon how the circulations of passengers around the network are managed more immediately. It became clear that logistical power is by no means exclusively digital, nor is it smooth or seamless. Rather, its unique character is expressed precisely in how it seeks – through the meticulous arrangement of material, sensory and affective cues – to manage forms of friction, whether physical obstacles or psychological hesitations. Moreover, it was claimed here that, in response to the aforementioned financial pressures, governance of the Underground environment increasingly involves balancing the imperative of onward movement with the need to boost

revenue streams through retail and advertising. In part through the possibilities of 'real-time data', but also through the flexibility of the material environment and its range of aesthetic and affective cues, the potential is suggested for extracting added value from the duration of circulation itself; from within passenger journeys.

The issues raised by the collective points made in these chapters are to be discussed below.

7.1. Introduction

The intentions of the chapter are as follows: to draw together the empirical findings of the previous two chapters and refer these back to the ideas put forward in my theoretical framework; to clarify and expand upon the notion of logistical power previously identified; to examine the nature of this form of power (how does it correlate to, differ from, and interact with, other forms?); to examine also its scope relative to the specific case examined here (the London Underground) and to urban societies more widely; finally, to examine the consequences of this form of power on a number of different grounds – the nature of urban subjectivity, and of urban (public) infrastructural spaces, especially in their relations with risk and value – and to think through the critical engagements and resistances which might be possible when confronted by it.

What I come to argue here is that what I am calling logistical power represents a noteworthy shift in the predominant aim, logics, techniques and technologies of liberal urban governance. As demonstrated by the case of the LU, the combined pressures of dynamic risk and financial scarcity lead to the positing of solutions which enrol logistics both to enable rapid, scalable responses to events, to minimise disruption, and to extract added value from the midst of circulation (including from its gaps and delays). Logistics is thus theorised as a form of power that is *extractive*, but the 'non-commodified outsides' which it extracts are more specifically *outsides within*; that is, the new sites of production and

consumption are 'discovered' within the duration of circulation itself. This necessitates a shift in critical political thinking on logistics away from the relatively simple prospect of disruption, and towards something that seeks consciously to represent and conceive of urban infrastructures differently, not simply along a binary of circulation and disruption but a broader, experimental set of questions concerning what the space of infrastructure is for and what it can do.

Before I get into the bulk of this work, however, a couple of caveats are needed. First, it is necessary to point out that some of this work is necessarily speculative. Some of the processes which I am identifying have only emerged in the last decade or so, and it is possible they will be short-lived. It is possible, for example, that a shift in the UK's political landscape could lead to a reversal of cuts to TfL and other public services, thus placing into question the motto of 'doing more with less' upon which I have premised the entry of logistical power. However, even if this were to happen, I would argue that research into logistical power and the ways in which it influences the governance of public infrastructures and other urban spaces remains crucial, not least because, even if its prominence did fade temporarily, the idea of 'doing more with less' will always be an attractive prospect, especially for the governance of societies informed heavily by commercial principles.

One thing I aim to make clear is that the case of the Underground examined here should be taken simultaneously as a particular, perhaps even unique example, *and* as a snapshot that, via the understanding of logistical power, is reflective of something larger. Put simply, this something concerns a pattern (or set of patterns) whereby the public, circulatory spaces of cities are increasingly expected to manage what is claimed to be an unprecedented degree of radical uncertainty, and at the same time to pay their own way; to generate added value via acts and processes of both production and consumption. The context in which I speak

about the Underground is related to a specific combination of socio-economic and political circumstances – informed by both an effects-based, resilience approach to potentially catastrophic risks, and the austerity culture of the post-financial crash era – but it is embedded, I would argue, in the deeper constitution of logistics through the intermingling of military and economic rationalities. The Underground is, in other words, a unique environment, but the patterns evident in its governance have potentially far-reaching implications, especially given the extent to which many other liberal urban spaces are characterised by the need to manage the uncertainties of circulation alongside the achievement of increasingly demanding financial targets.

Following up on the preceding discussions, this chapter will aim to clarify the re-formulation of VSS, which is critiqued and broadened into 'logistical power' firstly in recognition of the need – identified by both Neilson (2012) in the context of logistics itself, and Aradau and Blanke (2010) in relation to Foucauldian biopower – to account for *both* the military *and* the commercial (especially late-capitalist) influences of contemporary, liberal circulatory governance. Logistics is thus a form of power the origins of which are military, but which has been deeply coloured by its ventures in profit-oriented enterprises, especially since the so-called logistics revolution. It is a form of power uniquely practiced in the negative and the positive potentials of circulation; in (catastrophic) risk and (surplus) value. This point will be expanded by reconsidering Julian Reid's (2006) theory of 'logistical life', arguing that his primarily military-focused perspective must be supplemented by a notion of logistics as a means to extract value from circulation. Secondly, such a theoretical claim is justified on the basis that, whilst logistical power is orientated primarily towards 'vital' or 'critical' systems, what counts as such a system is a matter of decision, and as such is a flexible category (Aradau, 2010; Coward, 2016; Steele et al., 2017). It is not to say therefore that logistical power cannot exceed the bounds of a given system and even lead to the redefinition of

spaces and times previously considered outside this realm. Similarly, saying that the object is the system does not limit logistical power to working on or with technical components. Echoing the sentiment that 'critical infrastructure is people!' (Lipschutz, 2008: 206), logistics concerns the management of desires, sensations and emotions as well as boxes or data. Relatedly then, logistical power is considered to function through material and sensory components as well as digital technologies. Therefore, logistical power, in spite of the undoubted influences of the Foucauldian frameworks intersecting with it, is not Foucauldian as such. I would like to discuss logistical power as something which involves and accounts for the material and the aesthetic dimensions, something with which, as Thrift (2005: 10) has argued, a governmentality approach tends to struggle.

The insights of the two empirical chapters lead us to reflect back upon the literature, and to the place of logistics as a mode of power, beyond the exceptionality of the port and warehouse; those nodal points of supply-chain capitalism. Just as the mine was seen by Mumford as the archetype of the paleotechnic phase, the duality of logistics bleeds out into everyday life. The Underground as I see it is the product of that process of diffusion, but it is at the very same time one of its sources. As I will explain, it can be contrasted in this way with the airport, long posited as the city of the future. As opposed to the model city – that is, the city projecting a utopian fantasy for itself – the Underground's relation to the city; to the urban, is more that of *synecdoche*, a part which stands in for (but is also constituted by) the whole. Overall then, logistical power does not emerge out of a singular pathway of development. It is a multifarious idea composed of a range of partially interlocking but distinct concepts such as: 'logistical life' (Reid, 2006), 'city logistics' (Cowen, 2014), and the 'logistical image' (Toscano & Kinkle, 2015). To some extent, it also represents a negotiation between the notion of 'resilience', on the one hand, and 'smart urbanism', on the other. It is

a recognition both of the tensions between these two popular ideas, and the ways in which they attempt at various points to accommodate and borrow from one-another.

The chapter will trace logistics as a form of power, drawing it through, but eventually out of, Foucauldian modes of governmentality and the concept of VSS. The key here is to move from thinking about the governing of infrastructures as a predominantly negative task – associated with *managing* risk, or *responding* to the outbreak of potentially catastrophic events, so as to *minimise* disruption and thus *enable* the smooth functioning of the system; the smooth passage from A to B – to something of a more diverse and ambitious nature; something which seeks to combine those pessimistic exercises with the simultaneous necessity of *maximising* and *extracting* value. Whilst the aim of VSS was the protection of vital systems against their inherent uncertainties, logistical power attempts both to secure, to optimise, and to create new revenue opportunities out of the duration of circulation. The notion of extraction which I consider in more detail below takes the role of circulation beyond the matter of filtration; of filtering 'good' from 'bad', because circulation is not conceived merely as a method of distribution or positioning. It is, moreover, not simply about speeding up some flows and slowing down others, since the timespace of circulation itself is considered of potential value. In relation to the Underground user, it is about the 'passenger experience' – how can passengers be encouraged to participate in 'resilience', yes, but also how can they be encouraged to think their journeys productively, as a set of opportunities rather than merely a period of solemn drudgery interlaced with the potential for disaster? As we will explain, such an approach functions not only through particular forms of subjectivity – a responsibility for the network – but through a bodily imbrication with and mobile attentiveness to the environment and its cues; something akin to what Ross Exo Adams calls a 'becoming-infrastructural'.

The final sections of the chapter will ask both what the consequences of logistical power are and what forms of resistance it brings into play. In Virilio's terms, what kinds of 'accidents' does the twin demand to minimise risk and maximise value through circulation give rise to? To engage critically with logistical power requires, I argue, a certain scepticism together with a significant reformulation of what infrastructure as an urban space means; what can it (and our time spent within it) do for the city other than optimise the productivity of its circulations? What is needed here is a focus on the role of interface in not only representing the space (as network), but also directing our actions within it from one moment to the next. As I see it, this is a problem of entanglement which has a tendency to hinder political interventions into infrastructure, and particularly the Underground – as demonstrated by the recent actions of Extinction Rebellion. In order to demonstrate the possibilities for disentanglement, I draw on the idea of an 'aesthetics of delay', highlighting interventions which imagine the Underground non-logistically. Rather than strategic representations of the whole however, I turn to the example of 'ad-hacking', arguing that, echoing the iterative, scalable nature of logistical power, resistances must subvert from within, turning the arrow in on itself and providing alternative sensory and affective engagements.

In the subsequent section, then, we revisit a number of the key texts which were discussed in the literature review so as to reflect on them with the aid of the empirics. In particular, there is a need to adapt and to considerably thicken Julian Reid's conceptualisation of 'logistical life' so as to reflect the complexity, performativity, and materiality of how the Underground is governed.

7.2. Tracing Logistical Power and Subjectivity: Military and Corporate Influences

As outlined in chapter two, Neilson (2012: 331) suggests that the ability of logistics to govern circulation through the combination of generative processes with impositions and

facilitations constitutes a unique form of power which cannot be accounted for fully by the Foucauldian ideas of discipline and biopower (Foucault, 2003; 2007; 2008). We can understand this more comprehensively by returning to what is to date perhaps the most explicitly Foucauldian treatment of logistics – or, better, the most logistical treatment of Foucault – Julian Reid's (2006) *The Biopolitics of the War on Terror*.

For Reid, the militarily-derived techniques of discipline and biopolitics are united in their objective to pacify life into logistical forms. As such, the construction of mass public transportation infrastructures and their related spatio-temporal technologies (railway time; the levelling of relief, abstractions of geography, and so on) would be conceived as a 'logistical strategy'. For me, however, collapsing the distinction between strategy and logistics unwisely reduces the latter to the aim to impose a given state or order based on positional and communicative efficiencies. As I have argued, one of the defining characteristics of logistical power is the way in which it operates via feedback between strategic and tactical levels and perspectives. Logistics is not (just) strategic inasmuch as it works through adaptability; through just-in-time arrangements rather than through a model of the whole. Whilst the construction of an infrastructure of mass movement signals an interest in a 'logistical strategy', to consider logistics itself is to consider the ways in which the uncertain circulations which constitute the daily reality of such a 'system' are managed and optimised, taking into account the inevitability of disruption but also the possibility for opportunity from one moment to the next. This draws us back once more to the material focus of Mumford's work, for whereas the railway as merely a representation or embodiment of military techniques is 'logistical strategy', viewed through the notion of technics it is far more performative and incomplete. Logistics and strategy cannot be permanently or assuredly adjoined.

As was discussed earlier, logistics is military in origin, and Reid's primary concern is IR and its core questions of war and peace. It is clear for Reid that preceding Foucauldian studies – such as those of Nikolas Rose – have underplayed the military aspects of liberal governance (2006: 21). Nonetheless, Reid seems only to scrape the surface of what we have tried to understand by logistics. Rather than simply a means (either tactically or strategically) of maximising efficiencies of movement through the drilling of movements, the orientation and correct distribution of bodies and machines, logistics has always, as Cowen (2010; 2014) emphasises, been uniquely tasked with dealing with frictions and uncertainties; with strategic assessments, but more specifically with the necessity of constant *re-assessments*, attempting to render calculable and actionable a plethora of circulatory factors the interactions of which are not predictable in advance.

We might therefore question whether an overemphasis on military origins has a tendency to underestimate the diversity of possibilities represented by circulatory governance in its present guise. As Aradau and Blanke (2010: 3) point out, Foucault, whilst distancing himself from some respects of Marxism, recognised the importance of political economy to his work, and his notion of 'docile bodies' is, they add, "inextricably linked to the development of capitalism in the 18th century". According to Reid, the declaration, by the US and its allies, of a temporally and spatially boundless 'War on Terror' is the moment at which the military, logistical origins of liberal societies re-surface, as both the forms of subjectivity and communication – a generalised preparedness and vigilance – through which that total war is to be fought, and as the characteristic of freedom to be defended. This becomes the very 'quality' separating human life from that which threatens it:

> "In other words, in the present conditions of the War on Terror, the capacities of societies to practise a logistical way of life have become indistinguishable from conceptions of the 'quality of life' for human beings" (Reid, 2006: 35).

However, to say that this is the sole point of destination of liberal societies is, I would argue, to ignore the ways in which military logics have so successfully been applied in the service of profit-maximisation, and the ways in which that application has in turn shaped the nature and thrust of logistics, and consequently its associated 'quality of life'. It could well be then that Reid's focus on the War on Terror tends to keep the frame of analysis within the question of war and the military. The relation is primarily between war and civil society; war and the individual; war and the city; war and the population. In my analysis, on the other hand, this relation does indeed emerge from military techniques and these relations do persist today, but they do so in tandem with a return of another kind of logistics informed and transformed by work in the corporate sphere (the revolution in logistics). This supplement helps us to better-understand the productive inclusion of circulation, creativity etc. into the functioning of logistical power as a value-producing as well as risk-averting set of capacities. While value has always lain implicit to such theories, there remains a tendency to position logistics as a simply *enabling* force for production or accumulation. Similarly to how it was considered in some of the early military texts, logistics is viewed as something which sets the scene for the 'real action' of the battlefield; the destination. This seems, in the current context, to be an outmoded interpretation.

Logistics therefore involves a rethinking not only of how circulation is secured, maintained, recovered, and so on, but also of what circulation *does*; what is it made up of, and, from this, how and why it is (rendered) valuable. Or, rather, since the flows of people which the Underground helps to shuttle about were already valuable – they contributed ticket revenues and, as commuters and tourists, produced and consumed at their destinations – the question is of a re-rendering; a double-distillation from which to extract the something more, the undiscovered potential. With this in mind, we can say that the notion of 'using time economically' in Reid's conception of logistical life is an insufficiently thin description

for the hopes of logistics' forays into the governance of the urban. On this understanding, we might say that transportation is merely a matter of getting from one point to another as quickly as possible. If it serves this function efficiently, and we, as passenger-citizens, do not get in the way, then all is well. However, as has been shown, being an urban passenger is today about much more than submitting to a habitual, rhythmic, flow. It is about becoming imbricated in a multiplicity of circulations in addition to that of transportation. Via forms of real-time connectivity available on the move, one is being distributed through one circuit, whilst also participating in interdependent circuits of value production and consumption.

A similar critique can be applied to Collier and Lakoff's (2015) notion of VSS. As a theory of 'collective *security*', the emphasis of their framework is on the 'protection' of systems against risk or threat. In Forman's (2018: 233) words, it tends to follow the wider trend wherein "[c]irculation…forms the focus of security debates because of the way it is associated with particular kinds of danger; dangers that are regarded as being amplified by the increasing number, speed and intensity of the local/global flows that traverse and constitute modern neoliberal societies" (see Dillon, 2005). Circulation is thus regarded as something which (neo)liberal societies maximise as a means to an end, but which creates, in the process, a set of risks-to-be-secured. Circulation is necessary for linking sites of production and consumption, but the aim is to make these links ever-faster, consequently creating tensions between mobility on the one hand, and security on the other. The journey should be undertaken at the maximum speed that is feasible without causing frequent accidents. What logistics seems to do is challenge this opposition; to ask whether speed really has to be the sole aim. If the duration of circulation itself can be rendered into a valuable enterprise (rather than just its nodal extremities; its 'gate receipts'), then perhaps the assumed tension between security and mobility can be to some extent diffused. This leads us, in the

following, to take up a theoretical stance that thinks beyond the network and in particular beyond an emphasis on 'nodes' and networks.

However, before we go any further I would like to re-emphasise the key developments and features of logistical power. Although we are moving away from the idea of collective security and towards a form of power which encapsulates both security and value, it is still helpful to use the schema Collier and Lakoff set out: that is, according to the 'moment of initial articulation', 'object', 'aim', 'form of knowledge' and 'characteristic apparatuses':

Rather than a singular threshold **moment of initial articulation**, it is more accurate to talk about a period, between the last decades of the 20th century and the opening decades of the 21st, wherein logistics, having migrated from its military origins to spark a 'revolution' in the corporate sphere, and in doing so itself being revolutionised, begins to come back towards the sphere of public governance via a growing role in urban infrastructures in particular (Fig. 33). Here it intermixes with and supplements the already well-established use of military logistical techniques and technologies such as systems analysis.

The **object** of logistics is, at first glance, the same object with which Vital Systems Security is concerned. Like VSS, its governance of society is based upon the exercise of power through those systems which are critical to urban life. However, the **aim** of logistics with regards to those systems is expanded significantly in the face of the coexistence of what is perceived to be an unprecedented degree and quality of threat on the one hand, and, on the other, a constant demand for greater operational efficiencies and revenues. Rather than seeking only to "secure the functioning" of systems, therefore, logistics aims additionally to transform them into spaces and processes of value-added.

Rather than 'system-vulnerability thinking' – based upon attaining knowledge of the interdependencies of different elements – the **form of knowledge** that characterises

logistics is a situational, intuitive mode of thought in which awareness of system-vulnerabilities is paired with the ability to act on the 'within' of an event as it unfolds, thus minimising its scope; intervening in its spread. Notably, this knowledge is not restricted to the managing agencies, but distributed to human and non-human components which circulate within the system itself, encouraging ongoing assessments and adaptations to behaviour at both the tactical and strategic levels. This not only means that the governance of potential catastrophes are built into the everyday, constitutional, operations of society, but also that this readiness coexists with and in fact gives rise to new means for producing and extracting value.

Finally, whereas VSS featured, as its **characteristic apparatuses**, governmental preparedness and enactment in light of the potential for catastrophic risk events, logistics focuses on the rapid scalability of response enabled through 'networks-in-embryo' and 'smart', 'real-time' technologies of communication, calculation, and citizen sensing, but also via more mundane kinds of interface orientated towards the management of friction: material, (an)aesthetic and affective mechanisms – including signage, lighting, colour, and form – which working iteratively from within the duration of circulation. Notably, owing to the emphasis on form rather than specific content, such apparatuses can be deployed in relation to both risk and (commercial) opportunity, and are increasingly mimicked by the Out of Home advertising industry.

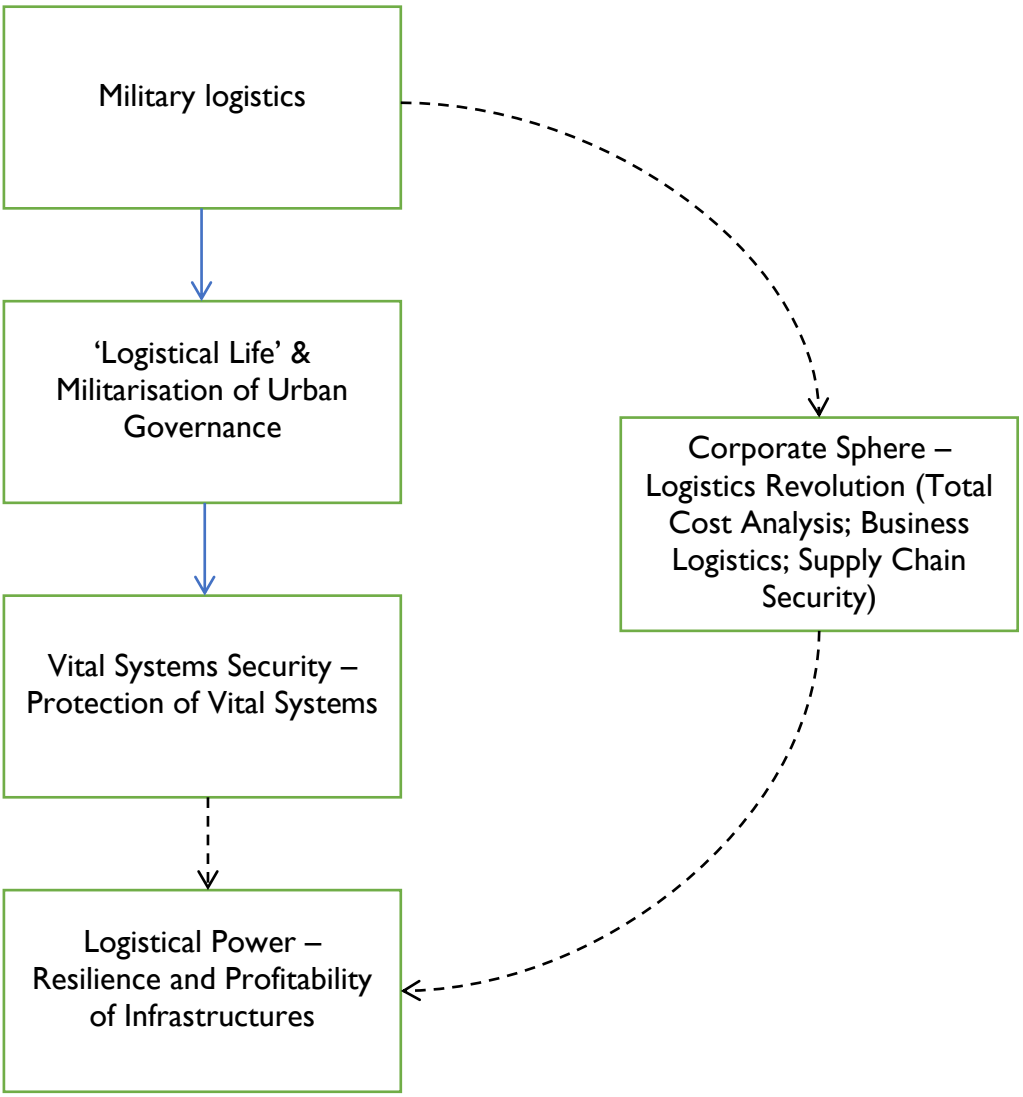


Figure 33: Logistical power as the combined influence of military and corporate logistics

7.3. (In)Securities (and Value) Beyond the Gateline

Martin Coward has recently taken a stand against the 'conceptual metaphor' of the network, bringing attention to the ways in which the normalisation of such a way of thinking about the world – especially in liberal urbanities – carries with it certain 'entailments': "a series of ontological assumptions…an understanding of what entities can or cannot do – and thus what they should or should not do" (2018: 445). One of the foreclosures this metaphor entails is the visual imaginary of the network as a two-dimensional plane of 'hubs' and

'conduits' (ibid.: 450). A metro map being perhaps the dominant example of such an imaginary to an urban viewer, it encourages one to think the space as a series of enclosed, static bubbles connected by enclosed, linear connectors. Whilst Coward argues that the "prioritisation of links" in the metaphor means that "nodes are understood to have no substantive content", we could argue, equally, that the presence of 'links' is reduced to a singular purpose deriving from their title. There appears to be nothing happening inside these lines; they harbour no potentiality other than to connect; to reach the bubble towards which they point. Although the importance of a node is defined by its connections – it is a point of (albeit temporary) immobility defined by its reach, its access to other nodes in the network – the connections themselves are just that, connections.

Coward's conclusions warn against the naturalised acceptance and proliferation of the network metaphor on the grounds that it justifies 'pathological sovereignty' by enabling connections to be made between phenomena of possible threat, thus justifying the expansion of surveillance and control without consideration of the social contexts in which 'nodes' (whether individuals or places) are embedded (2018: 455-6). Similarly, we might warn of the foreclosures of critical thought which are entailed in accepting nodes as singular, immobile spaces of waiting on the one hand, and lines as simple 'links' or 'connections', on the other. In particular, these assumptions fail to take into account how logistical power seeks to look – both literally and metaphorically – 'beyond the gateline' in its efforts to manage risk and cultivate value. Such mundane spaces 'in-between' used to be wilfully ignored, except, perhaps, by Dadaists, Situationists, and the like who saw them, precisely because of their unremarkable quality, as a space of potential subversion. With logistics' considerable focus on the interstices of circulation, however, this potential is not so clear cut.

Central to the theoretical task of the chapter therefore is to follow up on what Forman (2018: 233), borrowing from Barry (2013), has recently referred to as (in)securities 'along the pipeline'. Critiquing previous attempts to conceptualise circulatory governance, Forman looks to decentre from the emphasis on nodes, recalibrating to a greater focus on "the dangers that emerge *as entities circulate between nodal sites*" (2018: 232). This is a valuable contribution. In the context of my own case, it helps to both expand and concentrate the lens of analysis, shifting away from an exclusive focus on borders and points, and towards circulation itself. This does not mean that spaces usually considered 'nodal' are ignored, but that they are reconceived as the product of (and to some extent inseparable from) circulations. A station is not a point or a bubble (as it might appear on the Tube Map, for instance) but a density of (im)mobilities. A node does not merely contain; it processes. If it does not accomplish this, it turns into something else; another kind of space (*see* Dodge & Kitchin, 2004). Especially as agencies such as TfL look 'beyond the gateline' for additional circuits of control, so must we consider the multiple timespaces between concourses, platforms, and trains. However, what is not considered in Forman's analysis – likely informed by his focus on gas networks – is the notion not just of (in)security but also *value* along the pipeline. With a logistical form of power, what goes on between nodes; the roles and responsibilities of routes, journeys or pathways, are diversified in both a negative and positive direction.

Both centripetal and centrifugal, logistical power is not just about "letting things circulate"; of keeping things on the move whilst filtering out 'good' from 'bad' elements (Usher, 2014). It is more proactive than this, functioning as it does through the need to extract value from the very process of circulation itself. The Deleuzian notion of 'control', often seen as a critique of Foucault's ideas in the context of recent technological developments (Neilson, 2012: 328), is important here in that it theorises the continuous and dynamic government of

elements as they circulate, whilst also linking this form of power to a certain mutation of capitalism away from production and towards an emphasis on 'the product'; its marketing, distribution, and sale (1992: 6). While this is accurate, it omits the fact that distribution, the journey, the arrow, increasingly *is the product*; the supply-chain is *both* something which circulates products and something which, in circulating, produces. The interstices of circulation are where value is extracted and realised.

Logistics, then, is distinct in the ways it combines the circulatory function with an *extractive* logic. Moreover, the added value which logistics aims to extract is extracted from *outsides residing within*; from gaps, delays, shadows, and 'not spots' between A and B. As the next section will explain, this problematises the political potentiality of infrastructure based upon the binary of circulation and its disruption.

7.4. The Value of Disruption: Re-Patterning and Extraction from Within

Political studies of infrastructure at the present time seem animated by a certain tension. On the one hand, it has long been the underlying premise and promise of an infrastructural politics that failures, gaps, and breakdowns – of both an extreme and more everyday sort – hold the potential for (re-)thinking infrastructure and bringing into question the settled, concretised inequalities and injustices hidden behind their naturalised mundanity (e.g. Star, 1999; Cresswell & Martin, 2012; Sheller, 2018). On the other hand, however, this view is troubled in its simplicity by the ways in which gaps in many circumstances seem to beg fulfilment in ways that not only maintain or repair the status quo (quickly and without fuss), but in fact also make room (materially and discursively) for novel, more intensive techniques of calculation, ordering, and extraction.

This is evident in many, highly varied, situations. Mimi Sheller, for instance – after drawing attention to Lauren Berlant's (2016) proposition that infrastructural failure can open up

possibilities for "new organizations of life" through "glitchfrastructures" – relays the case of mass infrastructural catastrophe inherent in 'natural disaster'. Discussing the effects of Hurricane Maria on Puerto Rico in 2017, she points to how the damage caused by the disaster has created 'opportunities' not primarily for Puerto Ricans (many of whom have been forced to emigrate to Florida), but for land-grabbing "foreigners and 'vulture funds', not to mention quite a few billionaires, who are intent on techno-utopian experiments, from Elon Musk's arrival in Puerto Rico with solar panels and Tesla batteries, to 'crypto-currency' traders building their own vision of a libertarian, tax-free 'Puertopia' built on Bitcoin" (2018: 105).

This begs a return to the work of Kallianos, and his case of the (dis)ordering effects of infrastructural failure (or, rather, closure) upon waste management facilities in Greece. Rather than necessarily causing a rupture in the normal functioning of the system which might then produce radical political alternatives, it is argued that disorder in fact may fulfil a reinforcing function for systems of governance. As he puts it, "disorder contributes to the governing of urban infrastructure systems by becoming actionable and thus initiating a process of re-patterning" (Kallianos, 2018: 761). This may be read – as it was in chapter two – primarily as a mechanism of resilience, in the sense that disorder, in becoming actionable, allows for the system to adapt; to rework itself into more suitable forms of operation. It may be characterised, according to this interpretation, by the *absence* of radical change.

However, what Kallianos goes on to suggest is something more than this; not just an absence but a presence. Through such oscillatory processes "new technologies can be introduced, additional security systems adopted, new privatization schemes rolled out, and new meanings ascribed to its processes" (ibid: 772). The function of disorder is not just the reinforcement of order but its constitution and even its expansion or intensification. This

may be explained in the terms of Deleuze and Guattari (2004 [1987]) as a relation of deterritorialization and reterritorialization. According to their schema, the military origins of liberal regimes are historically influenced by encounters with the figure of the nomad, who constantly refuses to be contained to a particular set of positions or a particular territory. "Yet", as Reid explains:

> "this refusal…and the processes of the deterritorialization of sovereignty which this induces, becomes over time, Deleuze and Guattari argue, a constitutive function within the process of the reproduction of state power. The deterritorialising flows offset by the invocation of this war of movement against the state create new conditions upon which sovereignty is able to reassert itself, reterritorialising its boundaries anew, strategising the movement of life in redefinition of the limits of its power" (Reid, 2006: 44).

As a result of logistical instruments working to ensure resilience and adaptability, disorder appears more and more to be internalised, fed back into the reproduction of the system as it currently operates. This is not to say, however, that nothing changes, but that change occurs in a general direction shaped, iteratively and emergently, by a given set of logics and desires. According to Reid's analysis, the prominent logic is that derived from military thinking, of life's vitality pacified into an efficient, communicative and transparent logistical life. However, Deleuze and Guattari's object is not only war, it is also capitalism; the way in which liberal capitalist societies are matched by no other in their integration of – no; rather, their dependence upon – the very forces which at first refuse or subvert it.

As such, we can perhaps initially view the exercise of logistical power as an attempt to contain disorder to an 'internal' scale. This achievement is that of a continuous translation of what might occur as 'failure' or 'breakdown' – moments that we might say exist unto themselves – into relative notions of 'delay' and disconnection; events which imply not only negativity but also a temporariness, a sense of 'lack' which becomes actionable as something

to be compensated for, solved, or optimised-away. Yet there is, where capital is concerned, a positive, productive set of possibilities inherent to (the declaration of) lack. Logistical power can therefore be viewed as an attempt to conjure positive opportunity out of moments retroactively framed as disconnections or slowness-es. It is not a reactive exercise, simply restoring things to their former level of functioning (though this does play a role), but rather a creative, opportunistic moment *to be capitalised upon*, both metaphorically and more literally. The gaps which infrastructural failures open up are potentially not simply voids to be filled but 'seams' to be surveyed and extracted from.

Harvey has long discussed the 'spatial fix' required by capital; the way in which new territories 'outside' capitalism are continually opened up to create new sites of production and consumption (*see* Harvey, 1985). For Mezzadra and Neilson (2017), this relation between capital and its outsides is an 'extractive' one. Broadening the meaning of extraction beyond the literal 'dirty business' of taking 'raw materials' from the ground, they contend that "extraction involves not only the appropriation and expropriation of natural resources but also, and in ever more pronounced ways, processes that cut through patterns of human cooperation and social activity" (2017: 195), thus opening up a 'new urban frontier' through which to speculate, form, and harvest value. As discussed in chapter two, Danyluk (2018) has since identified a 'logistical fix', distinct in that the focus is shifted towards supply chains themselves rather than their nodal points. According to the rationale of logistics, value may be extracted directly through the maximisation and honing of circulations; by ensuring perfect timing (just-in-time), minimising surplus inventory, and so on. What we should add however is that the spatial logic of this fix could be described more specifically as a kind of *expansion* (via means of extraction) *from within*. As Arboleda (2019: 7 [online first]) claims, the continued effects of the logistics revolution have led to an advanced degree of functional integration between the productive and commodity 'circuits of extraction'; the circulations

through which value is produced on the one hand, and the "physical and social infrastructures" which facilitate its movement to market on the other. What must be emphasised is that this refers not only to the application of techniques to minimise costs and increase efficiencies, but also to the transformation of the commodity circuit itself into a site of extraction. New territories for both production and consumption are 'discovered' not only at the outer margins but also in the non-commodified gaps continually opening up at the centre; the figurative sinkholes presenting themselves via a narrative of fast, heavily-developed infrastructural systems that are at the same time classed as slow, delay-prone, troublesome and in dire need of sprucing-up.

With the Underground, the two meanings of extraction – literal and metaphorical 'mining' – meet in the self-same space. The construction of its subterranean passages was an exercise of literal extraction which opened up a space but also created a levée, founding the possibility for rapid subsurface transportation, A to B, and at the same time isolating and enclosing, forming a disconnection which today is made subject to re-extraction of a more figurative variety. Its 'frontier', likewise, is both that of solid rock – a material boundary through which communications technologies have only recently found the wherewithal to penetrate – and a more ideational boundary the breaching of which is accomplished through the redefinition of what may be conceived, ontologically, as 'value' to be extracted. Once public infrastructures and their mass mobilities are deemed of potential value, they are, in the same moment, defined as 'underexploited assets', thus setting in motion the necessary efforts to adequately exploit them. But what exactly are these newly valuable commodities? What form(s) do they take? One answer, following the critical literature on 'smart cities', would be to say that they are products of the digital age: so called 'big data' and, more accurately, the 'data fumes' which any smartphone-wielding body gives off (Thatcher, 2014). This would not be incorrect. As I have described, the extraction and exploitation of

passenger data plays a key role in the digital transition of the Underground. However, to say that this is an entirely novel and wholly virtual phenomenon would be to dismiss out of hand the broader historical (military and economic) developments of logistical thought. It would be to argue, somehow, that logistics has, through technologies of the 21st century, reached a phase wherein it leaves the troublesome realities of physical space behind to concentrate primarily on profiting out of the digital trails it leaves behind. On the contrary, logistics still deals very much with the physicality of movement, and not solely in order to minimise its inconveniences. It is through the immediate environment of the passenger as much as through the workings of data or the deployment of models that risk is hoped to be minimised, and value maximised.

This is not to underplay the role of data and the digital to logistics, but to emphasise how such tools function through their integration with architectures and sensory cues. The question is one of implementing a coalition of mechanisms (across code and space) through which passengers are made to feel calm yet alert; able to move continuously along a given path yet also compelled to search out; to glance back and forth; to check that one hasn't missed something. This is a dynamic process but one in which – in a further difference from Deleuzian control – friction is not hoped to be eliminated but managed or regulated. As such, rather than the strategic abstraction of the map or diagram, physical spaces under logistics come to resemble the *interface* as a platform which productively manages various forms of friction (see Ash et al., 2018). Nonetheless, this remains an ideal based upon a set of generalisations. Passengers are assumed to check, to react and to be affected in given ways. It bears reminding ourselves that a cue, no matter how seemingly universal and innocent, is always experienced differently according to one's position.[14] In the following

[14] To take one small example, whilst the 'accessibility' of stations is usually discussed in terms of whether there are stair-free exits and platform lifts, this belies the importance of the sensory aspects which are so central to

section, I will go into more detail as to the nature of these mechanisms, and in doing so I will position the Underground as a case that sits somewhere between airport and city; between an experimental zone and everyday urban life.

7.5. The Materialities of Logistical Power: Interface and the Management of Friction

> "If the airport is the city of the future (Sudjic, 1992; Virilio & Lotringer, 1983), then here is a glimpse of that which semioticians of the future must contend. The future is written in a Fruteger font on a high-contrast background; its syntax is fragmentary, its illocutions are overwhelmingly exercitive, there are arrows and pictographs everywhere. This proto-city is simultaneously information and architecture, sign and act, direction and instruction. The arrow modulates movement into traffic across multiple fields of exchange – data, people, machines, commerce, education. It is simultaneously tool and trope of the control society"
>
> (Fuller, 2002: 242)

The governance of the London Underground is about the technologies of 'real-time' and automated calculation, but, perhaps more importantly, it is about the hybridisations of those technologies with the materiality of both mobile objects and bodies. Logistics, as power, involves an assemblage of formal regulations (including spatial regulations), together with discursive and subjective orderings pertaining to certain forms of knowledge. However, following Thrift (2005), we need to emphasise that logistics is as much about materials and bodies as it is about systems and networks. It is about dealing with, accounting for, and adapting to their relentlessly physical and sensual nature. Logistical power works through signs in the sense of symbolic, ideological meanings and representations. But what perhaps separates it is the prevalence it gives to other, more direct kinds of sign: that *signage* which

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the directional nature of the environment. As well as the potential impact of so-called 'silent' stations on the blind, one might speculate upon the highly-regimented arrangement of 'sightlines' as experienced by somebody in a wheelchair.

increasingly populates our urban spaces, telling us, continually, where (not) to go, how to get to our destination, how to get in and get out, as well as when we will depart and arrive; how long we have to wait, and what we might do with our journeys.

Some may argue that the Underground, in the way I have described it, is little different from the airport terminal. And, indeed, there are some useful points of comparison here. Like the airport, the Underground is a 'directional' space whose design is characterised by the vital importance of intuitive wayfinding through the immediate material/symbolic hybrid of the arrow (Fuller, 2002; Krajina, 2013). The airport in some sense provides us with the pure model of this mechanism of the arrow, in relation to which the Underground environment necessitates a more nuanced understanding; a revised theoretical consideration of the art of wayfinding which enrols arrows alongside numerous other instruments. As was explored in some detail in chapter six, the LU is an exemplary case of (an)aesthetic design wherein all sensory aspects of the environment are taken into consideration, regulated, and channelled so as to minimise risks of disruption. Within this design, the arrow is by no means the only thing which "transforms information into an order", as Fuller (2002: 239) has it. According to the logic of the Underground's design, it is intended that, before we recognise the shape of the arrow or the cross above the gate, we catch the green or red hue; before grasping the idea that we need to move up the escalator to avoid a crowd building behind us, we are drawn towards the light.[15] Perhaps we could turn this around, then, and say that many things, in the Underground, are hoped to take on arrow-like properties. Colour, light, typeface, shape, architecture; all are intended to 'point' with immediacy beyond themselves. This function can be likened, therefore, to a multi-sensory variant of the notion of the 'logistical image' (Toscano & Kinkle, 2015) designed specifically to limit hesitation or

[15] This claim, as well as being based upon the desires expressed in the planning documentation, is also derived from my own observations and experiences, and is undoubtedly influenced by my aforementioned positionality.

reflection; to encourage the rapid execution of action. The association which Toscano and Kinkle make between the reification of this category of image and the landscapes of logistical capitalism is embodied in the attribution of a smoothness, symmetry and regularity – and with this a certain beauty – to what is in fact a performative, pragmatic set of procedures and adjustments.

In the case of urban infrastructures, it is the tensions and relative (de)prioritisations of the space which are banished from consideration. With the sustained financial pressure on the organisations which operate such spaces, the arrow comes into tension with the need to extract maximum value from the midst of circulations. Airports are once more a useful comparative case. As Fuller (2002: 238) notes, the privatisation of airports has made them answerable to the 'bottom line'. This means that, on the one hand, they must process flows at ever-faster rates, but, on the other, they must seek out all available opportunities for extra revenues. Airports are thus spaces which not only look to maintain a minimum level of performance in the face of disruptions, but indeed increasingly depend upon the value extractable from such pauses in order to function or survive (*see* Thrift, 2005: 219). Airports are not just about securing circulations; security and the various forms of conduct which surround them – from the obligation to turn up two hours before your flight, to the sense of relief we feel once we have successfully passed the tests of security – play an important role in creating the rudderless 'dwell time' in which we have little else to occupy our time but traverse Duty Free (Adey, 2007; Salter, 2007). However, the Underground is at the same time distinct from the airport because, as opposed to the latter's 'store > forward' architecture (Fuller, 2009), the imperative on the Underground is continuous movement – or, more accurately, the minimisation of periods of relative immobility to a matter of seconds or minutes. Unlike the purposive manufacture of dwelling in the fragmented malls of the airport terminal, the pressure of the Underground system means

secondary functions – retail, advertising, entertainment and so on – cannot be afforded if they risk obstructing passenger flow.

As such, perhaps a more telling comparison can be found not in airports but on planes themselves. In the skies, airlines increasingly supply (often advertisement-laden) WiFi access, and in-flight entertainment systems are beginning to develop ways of encouraging passengers to indulge in extra moments of consumption during their journeys. The in-flight route map in particular has been identified as a site of potential for so called 'air-to-ground' retail, monetizing the high 'eyeball count' of such maps by providing real-time information and advertising about the destinations one flies over and, in future, the ability to book hotels and restaurants, and buy tickets to sites and events (CNN, 2014; Panasonic Avionics, 2019). Again, however, the airline customer strapped into their seat for the long-haul contrasts with the Underground passenger as they wind themselves through tunnels and stairways, or squeeze themselves into a carriage for a few, two-minute stops. If the Underground system is subjected to the demand for doing more with less therefore, this must take place 'along the pipeline' (Forman, 2018), in the very process of circulation itself. The mechanisms for both building resilience to risk and extracting value must take into account the physical movement of bodies and the corresponding shortage of time for processing information. Like the notion of dwell time, this is an idea which accepts the inevitability of friction and seeks to turn it into something productive. Unlike that notion, the lacunas it attempts to capitalise upon are less akin to dwellings – boring intervals in which one has 'time to kill' – than minute gestures of a mobility which is continuous but frequently on the brink of uncertainty, anxiety or frustration.

The Passenger Experience Economy

As the recent studies of passenger experience demonstrate, there is a growing recognition by organisations like TfL and London Underground that it is neither possible *nor desirable* to conceive of journeys as something simply to be minimised to the benefit of time (and money) spent at destinations. This is on the one hand to take into account that journeys are about experience as well as efficiency, but it is also an attempt to realise the value of such apparently 'dead time'; to conceive of it in relation to an 'experience economy' (Thrift, 2005). This is where the adaptability of logistical techniques comes in, the aim being to increase the responsiveness of material space and bodily movements in circulation. For instance, the previously-discussed *Design Idiom* speaks of the potential for lighting systems to be remotely controlled and adjusted. This presents "the potential for adaptable and changeable spaces – triggered by their occupation or by external conditions" (TfL, 2015: 192). Similarly, the *Signs Manual* highlights the importance of 'switchable signs'; that is, signs whose content or direction may be altered, enabling the re-routing of passenger flows in the event of disruption or emergency (2002: 36; Fig. 34). However, like the aesthetics discussed in chapter six, this same dynamism is applied to the art of advertising, with the development and growth of digital advertisements that – making use of the passenger data produced through WiFi and other forms of connectivity – can be switched to target particular audiences at particular times of day or in particular areas of the network (Cronin, 2008). Advancing upon their 2016 study then, Exterion Media's (2018) *The Engagement Zone 2.0* lauds the possibilities of 'full-motion' advertising not only in terms of its ability to catch the attention of mobile audiences across 'multiple touchpoints', but also for 'driving search online' – that is, increasing follow-up internet searches of products encountered through the ad.s – and generating an uplift in 'emotional response'.

Figure 34: Switchable 'way out' signs for directing flow at Southwark (source: author's photo)

Such trends are not restricted to the Underground. A recent article in the technology magazine *Wired* titled 'Your commute sucks. Here's how it will get way better in the future'

emphasises this shift in attitudes by turning away from a logic of speed and towards the potential for longer, but more pleasurable and productive journeys. Enabled by technologies such as WiFi and real-time data, "Transport", the author argues, "could provide personally-configurable spaces that meet the needs of mobile workers, which may range from rest and relaxation (sleep, meditation), to reading, creating, eating, talking, and learning." (Keane, 2018: n.p.). Despite the inclusion of rest and relaxation, the main orientation is towards productive activities, whether carrying out work itself, or preparing for/recovering from its travails. To this end, the article also mentions the possibility of "mobile meeting rooms" for 'collaboration on the go'. As has been suggested by, for example, Amin and Cohendet (2002), the aforementioned idealisation of flexibility in corporate strategy has been accompanied by attempts "to make 'everything in between' to do more than align dispersed competences, to make it count as a formative space" (2002: 96). Communication and transportation, in other words, do not simply bring people into contact; they are ideally their own 'formative space' for the production of knowledge, ideas, and, ultimately, value.

There is certainly a subjective and even moralistic dimension to the view that journeys are not 'dead time' but rather constitute timespaces of potential. This relates, perhaps, to Ben Campkin's (2007: 70) Kristevan question of "how…'spaces of abjection' in the late modern city differ in form and materiality from those associated with the urban spaces of the industrial or Fordist metropolis". One might answer this by saying that the 'dirt' of the late-modern city consists of the wasted journey. For instance, whilst in some ways simply registering how passengers choose to use their journeys, studies such as that referenced above are also normative; carried out with the aim to shape those choices, knowing that doing so could leverage added revenue not only through increased ticket sales, but also through secondary sources such as advertising. This is illustrated, for instance, by the notion, put forward in a study carried out by TfL in collaboration with the market research

company 2CV, of 'tube etiquette'. Although the report finds that passengers use their journeys for an array of tasks, the general conclusion is that "[p]lanning the time spent on LU helps to maximise it's [sic] potential" (TfL & 2CV, 2016: 26). "Regular LU users", the report goes on to assert, "are more likely to be 'planners'" (ibid.). These regulars can be distinguished from less practiced passengers on the basis that:

> "There is a certain 'tube etiquette' among planners, who engage more in 'solo' activities…Irregular tube users are more likely to be chatting to a friend or eating – this goes against 'tube etiquette'; they are less likely to rate their journeys as productive" (ibid.)

Whilst a large range of behaviours are admitted, productivity broadly conceived is eventually taken as the measure of a journey well spent, allowing for a morally-tinged divide between those who follow 'tube etiquette' and those who 'go against' it.

The solutions proposed by the study include the provision of "[a]lways on" connectivity, as well as personalisation using passenger data, and "in-carriage digital experiences" (2016: 32). It seems then, that poor 'tube etiquette' caused by a failure of 'planful opportunism' may be overcome by shaping the environment to allow 'just-in-time' access to forms of stimulation, whether of work or leisure. Whilst some forms of social interaction are of course opened up by such access – checking social media, or emailing a colleague – others, such as 'chatting', are hoped to be avoided. Similarly, whilst certain sensory experiences could be provided for through in-carriage entertainment, others (the smell of food; the sound of someone eating) are deemed unsavoury. These are, of course, points which have been covered thoroughly by specialists in the politics and sociology of public space (e.g. Mitchell, 1995; Atkinson, 2003). What is particular here, however, is that the boundary of productive/non-productive is not that which divides between those who circulate and those who don't, or even between the 'paying customer', and those who circulate illicitly. Rather,

since logistics calls for added value to be discovered *within* circulation itself, it is no longer trivial from a managerial perspective whether one has a 'productive' or 'unproductive' journey. However, rather than primarily a subjectification which attempts to change norms of conduct, the solution is seen to lie in the provision of connectivity and stimuli, to entangle people more deeply with the stream of notification so as to maximise the opportunity for productive engagement.

This brings us to a more general point. As Fuller suggests, if the airport is the city of the future, then the arrow-form is its semiotic representative and may well constitute "the tool and trope of the control society". But what if it is not the airport but the metro which, with its logistical, just-in-time arrangements of circulation, friction, risk, and value, is the city of the future? If, for Lefebvre, the spaces of high modernity come to resemble their abstract representation, this tends to bring us to the strategic notion of the map or the plan; the network of nodes and conduits. If we consider instead the oscillatory feedback loops of logistical power, and its work on and through the gaps in the system, then we are better thinking of spaces as coming to resemble an *interface* – interface as a platform for the management of friction (Ash et al., 2018). Whilst Ash, Anderson, Gordon and Langley's work is on the specific function of digital interface design, their insights are also applicable to more material forms of transition. Friction, for them, is "a series of bodily and technical obstacles or hesitancies that interrupt, slow or stop a user from completing a task within a digital interface, such as choosing a service or buying a product. Friction is a matter of attempting to not only produce smooth experiences, although that is part of what is being done, but of producing the possibility of a transition between thresholds at the right time" (2018: 1138). As such, "[d]istinct from the smoothness of constant modulation (Deleuze, 1992), power in relation to interface design is…a matter of producing continuities and discontinuities that work together" (ibid.) The authors then make a direct comparison with

the logistics industry, noting that in the design of interfaces, as in the operations of logistics, "friction can also be productively introduced to help achieve the completion of a task, as long as this friction is carefully managed" (ibid.).

Whilst the capabilities of the arrow are tied closely to the notion of the Deleuzian control society as a materialisation of a continuous form of direction – never quite giving us the whole picture; only ever the next course of action – I would argue, with Ash et al. that such a conceptualisation remains too smooth; it does not account sufficiently for the performative dimension and the productive indeterminacy of this environment from one moment to the next. As we are pointed forwards, on the lookout for the next arrow, we are simultaneously lured to glance elsewhere, towards other signs which turn out, after a moment, to be promotional rather than informational; invitations to consume as well as to keep moving. The Underground functions, then, through what we might call an economy of glances, if the glance is conceived not only visually but in relation to multi-sensory experience. It is the back and forth of the glance; its flitting and fleeting nature, which enables passengers to be adaptable to the possibility of risk and opportunity alike whilst maintaining their circulation.

7.6. Doing More with Less: The Shared Context

TfL is by no means the only public agency whose funding has been subject to cuts and demands for greater efficiencies in recent years, nor is it the worst hit. The idea of logistical power thus appeals both to the specifics of the LU, and to a more general context of risk abundance and financial scarcity felt by the suppliers of public infrastructures and services, in London, and across numerous other urban societies.

There are, of course, limits to the application of logistics as I have understood it here. For one thing, it is clearly problematic to project logistical power as a universal model, in the

process yoking together a city like London with drastically different urbanities, from Paris to Rio, Dubai to Lagos. This is where the importance of Cowen's (2014) distinction between 'logistics cities' and 'city logistics' becomes particularly clear. On the one hand, a complex such as Dubai Logistics City has been characterised as a zone of exception in which all kinds of rights are sacrificed for the sake of a perfect regime of control and flow. On the other, it has been pointed out that the smooth functioning of infrastructure is a somewhat alien concept for many outside the heavily-developed, post-industrial city. In many cities of the global south, McFarlane (2010) argues, the normalcy of infrastructure is characterised by frequent failure, disconnection, and improvisation (*see* Simone, 2015). London, of course, sits somewhere between these two poles, as a city deeply influenced by the idea(l)s of logistics, but in some sense haunted by its modern pasts; by the material remnants of systems once considered cutting edge but now conceived as proud but burdensome relics to be reworked, upgraded, and optimised. The Underground (along with the Victorian sewers) is perhaps the quintessential example of such a system. And, as such, logistics must be thought of here, perhaps more than anywhere else, as a practice of retrofitting that is both material and calculative.

The seeming clarity of a divide between one kind of city built to a total plan, *ex nihilo* and another built incrementally, in the gaps is, however, perhaps more a matter of spatio-temporal scaling than stark reality. Logistics cities, in many cases, have achieved their apparent utopianism only by capitalising upon (the orchestration or declaration of) lacks reframed as opportunities for new connections and efficiencies. One of the many infamies of Boris Johnson's short stint as Foreign Secretary was, in October of 2017, to praise the great potential of Libya's decimated city of Sirte to become 'the next Dubai' – all they'd need to do, Johnson speculated jovially, was clear away the bodies (BBC, 2017). Such logistics cities; such visions of perfection, are created through the exercise of city logistics on a grand scale,

working opportunistically with the absences created by violence. As well as hinting again at the relation Reid (2006) observes between biopolitical and sovereign forms of power, this kind of example both inverts the order which he focuses on, and points to something more specific. Rather than sovereign power returning to reterritorialize the deterritorialisations exercised (over an ever-expanding space) by the biopower of liberal institutions and ideas – as in the destruction of Iraq via the targeting of infrastructures themselves constructed by Western humanitarian organisations (see Reid, 2006: 53-4) – Johnson's comments allude to the proceeding deterritorialization whereby liberal actors step in once more, attempting to build new worlds out of the rubble. As I have already argued, Reid, in his focus on war, does not sufficiently account for capital. If the kind of life that is hoped to be 'fostered' is logistical, then it refers not only to governing circulation in the name of military readiness, but also in the name of the discovery and extraction of new sources of value. The warzone is the extreme case of a space which is not-yet connected and thus perfectly primed for connection. This is precisely why logistics must be understood in its performance: because it always comes into play relative to the identification of gaps and frictions in need of filling in or optimising out.

It should also be noted that the London Underground and those individuals that have, in the past and more recently, been tasked with governing and securing it, are today engaged in processes of knowledge export to cities around the world. A number of my interviewees had been engaged – either through their careers in UK transportation and policing, or upon retiring and setting up their own businesses – in projects to train in skills of transport security, resilience and strategic thinking those in charge of metro and other transport systems in places such as India, Qatar, and Dubai. Furthermore, TfL in fact explicitly lists, among its business strategies for boosting secondary revenues over the coming years, growing efforts to make the most out of its 'world-leading position' by building a dedicated

consulting arm, and allowing elements of its brand to be deployed, for a price, elsewhere (see TfL, 2019b: 49-50; 117-19).

The Underground is thus a point of origin for models which are disseminated across the globe, and at the same time a particular, peculiar environment. It is in this sense that Toscano and Kinkle (2015: 203) argue logistical space to be "both generalising in tendency – pushing its horizon of integration ever further – and as wielding its logic over circumscribed 'laboratory' spaces, compartmentalised enclaves of which the distribution warehouse and the containerised port are paradigmatic cases". As well as proliferating its particular skillset across the globe, the Underground in its relation to the city is an example of both of these tendencies; it is, we might say, not quite city but not quite (air)port either.

This is, in some sense, a return to the problem of 'crowded places' and 'complex and built environments' posed in chapter five. Open yet closed, circulatory yet dense, constantly occupied yet by a community that is largely anonymous and transitory. This conundrum together with its proposed solutions must however be seen in relation to both potential risks and potential opportunities. The question of how one makes such spaces and their populations 'resilient' is always-already tied up with how one makes them valuable. This 'value' is often assumed to be the value of the destination, of the tourist sight or the site of production, but this assumption makes the mistake of leaving aside those conduits of value which are stretched out along the well-trodden but unspectacular routes between A and B. Circulation has recently been associated, and rightly so, with the unintentional production of risks, but forms of mass mobility have over the course of their history always given birth, also, to the art of producing and extracting value on-the-go. With logistical forms of design on the Underground, as outlined in the previous chapter, this is manifested in the production of double circulations; chains of advertisements which echo chains of signage.

More specifically though, the potential for logistics to be an especially influential form of power – whether through privatisation, or a more subtle creeping rationality – comes, as we have said, from its appeal to the notion of doing more with less. Perhaps we can explain this better however by referring to one of the Foucauldian analyses critiqued by Reid (2006) for its inattention to the military origins of liberal regimes: that of Rose (1989). In *Governing the Soul*, Rose pinpoints the importance of the psy-sciences as being particularly appropriate to the governance of modern neoliberal societies because they allow for the rationalisation of and intervention into 'private' realms. Somewhat similar to Dunn Cavelty and Kristensen's (2008) characterisation of CNI, they permit something otherwise put out of reach by the ideology of individualism and private space – the personal lives of citizens – to be brought back under a degree of public influence. These are categories and ways of knowing therefore which permit a certain *reach* of power from public into private.

With this in mind, logistical power appears to operate in the opposite direction. It is a means through which private enterprise can gain entry into and a degree of influence over the otherwise open, transitory, and ambiguous spaces and systems of 'public', everyday life. It does so by to some extent anticipating the deep public concern with catastrophic risk, whilst at the same time seeking to seamlessly integrate this with commercial interests of maximising revenues and expanding the scale of operations. Inverting the logic of C(N)I, which identifies among private companies a lack of 'resilience' and appeals to their self-interest via ideas such as 'reputational damage', logistics identifies in public infrastructures a lack of connectivity, translating logics of extraction and profit-maximisation into a frugal language of safety, sustainability and public service.

As opposed to the techno-utopian idea of a logistics city, associated with a heavily corporate, dehumanised vision, city logistics is a better characterisation of this influence. It is

marked, especially, by its willingness and expertise in relation to working with friction and scarcity. It is due to this relation that Exo Adams argues for an understanding of contemporary cities as characterised primarily not by 'smart urbanism' but 'resilient urbanism', seeing the latter as the former "come of age in an era of climate crisis" (2017: n.p.). In the case of logistics, however, the crises are multiple, and the responses, as I have argued here, correspond not only to resilience (relative to risk), but also to the generation of added value.

Given its act of 'reaching' into the governance of public infrastructure, logistical power is not as straightforward as privatisation. There has been a great deal of very worthwhile debate recently concerning the privatisation of urban transportation, in particular via digitally-mediated, on demand services such as Uber. There is a growing tendency, it seems, for the personalisation of experience to feed also into a personalisation of circulation, damaging the appeal of public transportation as something which is insufficiently flexible; it is not tailored to one's specific desires and destinations – it does not go to (quite) the right place, nor does it arrive at (quite) the right time. However, this assumes a straightforward and immutable boundary between 'public' and 'private' transportation. It therefore omits the fact that public services are influenced by corporate logics, and are operated through contracts awarded to private actors. In a sense this corresponds to the notion of the New Public Management (NPM), but it is more specific, relating not only to the nature of ownership or influence but also the particular kind of expertise, orientated towards circulation. Again, this is a matter of the retrofitting inherent to the practice of city logistics, as that which – rather than a totalising project – incrementally and partially works on, restructures, and 'optimises' existing urban systems and spaces.

One example might be the trend towards Mobility as a Service (MaaS), characterised by the capability – enabled by smartphone applications – to combine and compare a range of public and private transportation options for a given journey. On the one hand this can have a positive effect in that it potentially makes public transportation a more attractive option, able to be combined with more flexible, tailored private solutions. However, of course, it also means that the narrative – the identification of problems and their proposed solutions – are framed by the companies providing the platform. Often, again, this narrative is one which paints the city as overly complex and in need of simplification through connectivity, data and private solutions which step in to fill the gaps in public provision. For instance, an update to the Citymapper app's now-defunct 'Smartride' service in November 2018 included a 'SuperRouter' function through which users could view all "new floating transport options". The first line promoting the update sets the scene concisely: "Mobility in cities is getting more complicated". Inherent in this declared complexity is both a certain trepidation – mobility is tricky; without the right information one might easily get lost or thrown off course – and an undeniable excitement in the growing choice which exists in the space between A and B. This choice is not simply between faster and slower journeys; it is increasingly about *what kind of journey* one wants.

We might argue, therefore, that MaaS – if we are not careful with it – allows those with the technological and financial wherewithal to dip into and out of public transportation as one among a range of options, or use it as a base product to which numerous 'optional extras' can be added, and that this leads to the further neglect of public services and those more heavily reliant upon them. This is a question for another project. Perhaps more subtly however, the emphasis on comfort, convenience, and productivity; on complex, difficult urban mobilities made easy, has the potential to reflect back onto the idea(l)s of what public transportation should be. The advertisement reflected upon in the introductory chapter,

that of the taxi firm Addison Lee, typifies the promise of such private options for urban transport with its tagline: "We'll get you from A to USB". With the future emphasis on how to best allow passengers to use their journeys productively, often necessitating continuous access to WiFi or mobile data, the notion of A to USB might be applied as a broader metaphor for how logistics acts to transform the aims of urban infrastructures. However, more than just a digital supplement, that which is discovered between A and B constitutes a wide range of digital and sensory mechanisms; an interface for managing frictions and risks, whilst also extracting value. Exo Adams' point about resilient urbanism is that it is produced together with a subject that is uniquely entangled with it; a subject undergoing a 'becoming-infrastructural'. As such, it becomes more and more difficult to conceive of infrastructure outside the reference points of this entanglement.

In the final section below, I try to elucidate how we might critically engage this form of power as well as the forms of subjectivity it produces and is produced through. Since logistics works on and through frictions, slownesses, and (perceived) gaps, a conception of resistance along these lines is not easy to develop. The key may lie therefore in moving altogether beyond the spectrum of slow and fast; circulation and disruption to instead think anew about how we use and assess infrastructural urban space. This can pick up and advance upon some preliminary work done on conceiving phenomena such as waiting and delay as experiences in themselves, rather than disconnections or immobilities characterised by absence (of movement; of stimulation). Furthering the point, reiterated throughout this thesis, that infrastructure has always been people, it will also look to examine the political potential for seeing such spaces not as networks for the purpose of getting from A to B, but as 'sociality'; as a form of witnessing or sensing the city.

7.7. Critically Engaging Logistical Power: Mobilising an Aesthetics of Delay

> "What it is possible for people to do with each other is largely a question of what it is that exists *between* them, and how this *between* can be shaped as active points of reference, connection, and anchorage. Infrastructure exerts a force – not simply in the materials and energies it avails, but also the way it attracts people, draws them in, coalesces and expends their capacities. Thus, the distinction between infrastructure and sociality is fluid and pragmatic rather than definitive. People work on things to work on each other, as these things work on them."
>
> (Simone, 2015: 375-6)

If logistics is not just a matter of speed, then slowing things down will only do so much; if logistics is not simply about smoothness or continuity, then interruption by itself is not sufficient; if logistics is not a techno-utopian transcendence but continues to work on and with both matter and the sensory, then the simple invocation of these factors has little inherent purchase. It is only by understanding in detail how logistics really does function – how it performs – that we can begin to think about what resistances or critical approaches might look like. More specifically, it is only by recognising that logistics works on *what circulation does* that we can begin to ask *what else it can do*.

One of the distinguishing features of logistics identified in the above may be characterised as the extent to which it takes as its object not just 'circulation' *per se* but its interstices, whether the 'within' of the possible emergency or the direction of the step and glance as a passenger moves through the network. As such, we can say first of all that critical attention must also be focused on such interstices; on how to subvert or otherwise reshape from within circulation's midst. Brassett and Vaughan-Williams (2015) have warned against reifying the idea of resilience by assuming it to function successfully and consistently, thereby understating "*the contingency of practices of resilience*" (2015: 38). There is a similar point to be made about logistical power. Logistics is not homogenous in its performances because, as

opposed to other forms of power which function through the internalisation of procedures and responsibilities, logistics is inherently situational or momentary. It functions through 'sign trails', logistical images, and countdowns; through continuous instructions and sensory cues. Again, this leads us to critique Reid's conception of logistical life as a Foucauldian form of 'self-conduct'. Whilst it may well be that urban citizenship involves feelings of responsibility for the continuity of circulations, the way that this responsibility manifests itself on an everyday basis is not internal to the subject but is rather performed through iterative interactions between bodies, spaces and times.

Although he discusses the city via a framework of 'resilient urbanism', the form of subjectivity (if we can call it that) evident here does bear resemblance to what Exo Adams (2017; 2018) has recently termed a 'becoming-infrastructural'. It is an expression of the fact that we are implicated into systems of circulation not only through some sense of responsibility for them, but also in much more bodily, material ways. 'Becoming-infrastructural' refers to an entanglement that works across and through embodied experience. The internalised responsibility of logistics as such cannot be reduced to particular forms of behaviour. It is not, for instance, directly that of 'being on time'; of 'getting there as fast as one can'; even of 'being productive'. Rather it is looser than this, and it depends upon the cues offered up by the environment at particular moments in timespace. The responsibility, therefore, is more fundamentally that of 'checking'; of 'glancing'; of paying attention to the stream of notification, and of adapting one's choices accordingly. This is akin to something that has been much-discussed in the context of security and counter-terrorism: the capacity for 'vigilance', but it is much more open and indeterminate, since we are on the lookout for a great range of things besides the category of the 'suspicious'. The continuation of circulation remains pivotal to this responsibility. Judgement is not passed on the exact nature of journey, so long as that choice itself is taken

without more than a moment's hesitation. This constant recourse to cues at every turn means of course that the system is only as reliable as its latest iteration, and herein lies a potential for performances that turn infrastructure in directions other than the logistical.

Aesthetic and Affective Fragility: the Persistence of Friction and Shadow

With logistical power functioning through interfaces which work aesthetically and affectively to regulate friction and hesitation, whilst also seeking to extract added value, the fragility of circulatory regimes (Chua et al., 2018) resurfaces in the inability to eliminate material and sensory traces of friction, and – as in the aforementioned case of busking – in the socio-spatial re-orderings which arise as a result of attempts to balance out conflicting priorities.

As advertising revenue becomes more crucial to the continuity of the system for instance, new forms of dynamic and experiential marketing begin to take precedence. However, the pressure is also intensified on other sensory interactions to conform to a commercial model, and then to make way for more monetarily efficient uses of the Underground environment. This exposes the fallacy that circulation may, through technological developments, be rendered endlessly more rapid, more flexible, more resilient and secure, whilst at the same time cutting costs and increasing revenues – without the appearance of cracks and without the exclusion of certain behaviours and actors. For instance, the need for passengers to occasionally take rest from circulation – because of individual need or desire, or because of unanticipated delay, produces a requirement for flat surfaces against the principle of curvature and circularity. As in the case of a platform bench, such surfaces in turn create undersides, patches of darkness and shadow (Fig. 35). And where such occurrences are so rare, their inevitable presence becomes an intensified space of doubt and perceived riskiness.

Figure 35: A rare shadowy recess, below seating at a Jubilee Line station (source: author's photo)

The passenger is especially vulnerable insofar as their sense of control – their ontological security – becomes increasingly reliant upon the continuous points and reassurances of the spaces through which they move. And, since the affective and aesthetic devices deployed by TfL are mimicked by advertising companies, it is not only navigational but also commercial cues which constitute this reassurance (Krajina, 2013: 237-8). For instance, one of the participants in Krajina's study of Underground advertising recorded a sense of trepidation when encountering a routeway free of the usual chain of hoardings, suggesting that LU passengers desire advertising – regardless of its content – not simply because they wish to be entertained but because they wish to be reassured against the otherwise unknowable environment in which they find themselves (2013: 240-1; *see* Fig. 36). It is through this type of logistical relation that genres are blurred, and comfort, control, safety, and security come to be linked not only with the continuity and resilience of the circulating whole, but also with certain sensory indicators and interactions (and not others).

Figure 36: Bare wall surface, Oxford Circus (Source: author's photo)

Identifying the gaps, tensions and conflicts which arise out of this environment is one small step feeding back into a critical approach to city logistics more broadly. For if the Underground is certainly unique, it is also representative of a general context in which the desire for greater rates of circulation and accumulation under tighter financial constraints and demands for (feelings of) control and security, is leading to aesthetic and technological complexes which attempt to mediate all aspects of urban experience.

What forms, then, should interventions seeking to subvert or question logistical power take? First, they should be characterised by a healthy scepticism of the logic of 'doing more with less'. It is inevitably the case that extra efficiencies can be found in such systems. As May and Thrift (2001: 19) point out, speed being a relative concept, it inherently produces slownesses which we then perceive as something in need of optimisation. The point here however is that efficiency always imposes qualitative changes. Working as it does by distributing elements differently – in more 'optimal' arrangements – it always engenders, whether intentionally or unintentionally, (de)prioritisations which become manifest not only in the relative (im)mobilities of different groups, but also in the nature of experiences of circulation more specifically, from self-conceptions of identity and citizenship, psychological and social feelings of anxiety and frustration, or gestural interactions with sound, colour, and sign. The case of busking in the previous chapter offered one example of the ways in which both the experience and the social role of the Underground is re-ordered through the joint pressures of averting risk and maximising revenues.

Combined with the question of what a 'resilient' space looks and feels like therefore there is also the question of what a value-extracting space looks and feels like. If such spaces must fund themselves, rather than being subsidised, how does this alter the experiences and potentials of infrastructure? It should be emphasised that what is produced is certainly not

some sort of deadly serious, functional or sterile space bent on continuous movement. It is, however, a space of (an)aesthetics in Buck-Morss' terms; of interfaces through which sensory interaction is not closed off but carefully managed so as to keep to a tolerable or productive level the anxieties and immobilities of hesitation. This space does not preclude enjoyment or sensory stimulation in favour of an empty, functional environment, but it does seek to structure and order entertainment in particular ways, for instance as forms of 'solo activity' appropriate to 'Tube etiquette', or as modes of advertising and retail.

In the current chapter I have discussed the logistical governance of the Underground partly through the notion of extractivism. As Mezzadra and Neilson (2017) note, one of the depoliticising assumptions of extractivist metaphors is the notion that resources simply exist in the ground, waiting to be dug up and put to use. In this spirit, it is crucial to remember that, as opposed to the narrative often deployed by logistics corporations, passenger data does not 'exist' prior to its mobilisation; it is not merely an inevitable by-product. Logistics helps to define ontologically what is valuable and thus worthy of extraction. In attributing added value to the interstices of circulation, gaps, delays, and frictions are framed as resources. In the future visions of public transportation especially, it is imagined that the frustrations of delay might be rendered instead into comfortable and productive periods for work and leisure or peace and quiet. Disruption or breakdown will not disappear therefore, but the sensory experience of it *as disruption/breakdown* will, it is hoped, be muted.

One critical engagement therefore may be to insist against the idea of public infrastructure and the timespaces of circulation as 'gaps' which need to be filled in through more intensive, always-on forms of connectivity. This is to argue, as Bissell does, for a rethinking of the notion of 'waiting', away from a "productivist means-ends form of suspension that maps onto an itinerant and timetabled modern society" (2007: 282); a *waiting for*; a moment of

immobility in which one waits to get moving again, and towards an understanding based on waiting as an event-in-itself, an embodied corporeal experience which contains a potential to be otherwise (2007: 278-9). In contexts outside the London Underground, this philosophy has been expressed by the artistic provocation of International Airport Montello (IAM), an airport – set up by the collective Eteam in collaboration with local residents in the small town of Montello, Nevada – with a runway, baggage handlers, security checks, retail, waiting areas, but a distinct absence of flights (Paret, 2010: 27). This experiment helps us to rethink the experience of delay, suggesting that, for those framed as 'left behind' by globalisation and its logistical networks, life is considered as a perpetual state of delay. As Paret says, such an experiment offers an alternative to the (an)aesthetics of logistics and its arrow-like forms, instead constituting "what might be termed *an aesthetics of delay* that inverts the instantaneous perception of modernist aesthetics and the utopian promise of the airport" (2010: 30).

By broadening and articulating more clearly this idea of 'an aesthetics of delay', we might be able to develop a suitable set of responses to logistical power. First of all, when we talk of 'aesthetics', we must think of it in the full sense of *aesthesis*. This means talking about the widest range of sensory stimuli and bodily sensations that are mobilised through design and architecture. Crucially, it also means applying such an understanding to the 'digital', 'smart', and coded technologies and objects increasingly used to govern urban infrastructures. Such technologies may all too easily be reduced to the screen, and, in the context of the Underground, to the strategic notion of 'journey planning'. As in the case of Citymapper's 'Smartride' mentioned above, the digital thrives off a discourse characterised by what Dilger (2000) termed an 'ideology of ease' – a naturalised assumption that the easier something is; the less work and understanding we need to produce results, the better it is – but this is additionally foreshadowed by the declaration of growing complexity and uncertainty. Put

simply, the city is getting more frictious, more abrasive; the solution lies in the ease and comfort of the smooth. Yet the objectives proposed by the documents discussed above refer more precisely to 'strategy in pieces', seeking the governance of passengers through on-the-go interactions with interfaces, engaging a variety of bodily movements and 'gestures' in order to keep them up to date. Such gestural engagements are themselves an increasingly large part of economic models that seek to maximise value by focusing on 'user experience' (*see* Zehle, 2012), and we have seen how bodily and affective interactions are central to both safety and commercial potential on the LU. Thus, it is by thinking of all these stimuli – whether wholly or partly coded, or perhaps not at all – via the notion of interface, that we are able to capture their simultaneous relations to risk and value; to the balance between anxiety, hesitation, circulation, and opportunity. In addition, interface enables us to identify the 'sites' where logistical power is most clearly expressed, circulating as it does between tactical and strategic modes of thought, action, and calculation.

What, then, might an aesthetics of delay look and feel like? It is perhaps an interface, or a method of interfacing that fosters hesitation rather than minimising it; that causes one to pause rather than to move onwards; to consider delay as something other than a continuous search for stimulation. This shift in focus, it is hoped, can open up to further investigation the inequalities of experience produced and concealed in the series of momentary interactions of which interface is composed.

Aesthetics of Delay, Interfaces of Hesitation

Echoing Thatcher and Dalton's (2017) work on the 'data spectacle', it is important not to take for granted the representations of ourselves supplied via interface and logistical models; not to confuse ourselves with an element seeking ease of mobility (ease of production; ease of consumption) against the challenge and danger of the city. Returning to the broad ideas of

Lorey and Butler discussed in the literature review, with such an attitude of precariousness we have a tendency to forget the relative precarity faced by some more than others. The problem, as I have seen it here, is that we are not only responsiblised to view our mobilities in such a way; that is, we do not merely have access to such a perspective; to maps or plans. Rather, logistical power entangles us in and through the interface; through continuous streams and chains of direction and invitation. The problem of entanglement can be demonstrated by one recent attempt to disrupt the LU as a tool of political protest: the actions of the climate movement Extinction Rebellion (XR) in April and October of 2019.

In April 2019, XR, in an effort to bring widescale political and popular attention to the 'climate emergency', occupied a number of streets and bridges across central London. As Madden explains, this followed the technique of tactical acupuncture identified by Weizman, with the objective being not simply to stage a protest but to cause significant disruption which would spread throughout the city:

> "In interrupting motorised traffic in the heart of London, XR is simultaneously performing the disrupted world of risen seas, prefiguring the festival of a city transformed, and seeking to bring the system to a halt in order to make their message heard" (Madden, 2019: 2)

The general reaction to these protests, even for those brought to a standstill, seemed a sympathetic one. However, when XR announced they would intensify their activities by disrupting the London Underground, the response was far less tolerant. In response, TfL – on request of the BTP – turned off passenger WiFi connectivity on the LU in order to hinder political organisation. This move, carried out without pre-warning the public, drew heavy criticism for bearing a worrying resemblance to the actions used by embattled authoritarian leaders during the so-called Arab Spring (Embury-Dennis, 2019; *see* Geng, 2014). This both alerts us to issues of ownership and oversight in the potential role of

Simone's (2015) 'infrastructure of infrastructure', and to the difficulty of disentangling one's actions, whether explicitly political or not, from those same systems. In short, the disruption of one infrastructure comes to be dependent upon the smooth functioning of another. Crucially though, this is more than a matter of technological dependence. The entanglement is much deeper than this, and as such the effectiveness of political interventions require a broader transformation of infrastructure's aims beyond the logistical objectives of optimisation, resilience, and value.

Having called off their efforts to disrupt the Underground in April, XR tried again in October, and were successful. Activists boarded the roof of a Jubilee line train at Canning Town, delaying its departure. However, this technical success was not matched by success in the communication of its message. Whereas disruption to the road network had been greeted with understanding, mobile footage of the Underground protests featured angry commuters accusing the activists of hypocrisy and, in one case, physically dragging them from the train (*The Guardian*, 2019). Meanwhile, political and public figures across the board condemned the protests as being ill-conceived and counter-productive. Part of the argument behind this anger was that the Underground, as a system of public transportation, would in fact be part of the solution to climate change, and as such by disrupting it protestors were harming their own cause. This was not the system to disrupt. It was an ally, not an enemy, and should be left well alone. This attitude serves as a good example of how the "distinction between infrastructure and sociality" is currently conceived, and how we might conceive of it differently. If this distinction is considered as definitive, then the disruption of the Underground is considered as an attack on the infrastructure, and a threat to liberal life and resilient urbanism. If, however, we take Simone's suggestion to consider it as fluid, and more broadly to think the possibilities of infrastructure for providing "specific ways of witnessing or sensing" (2015: 375), then disruption, rather than simply being the negative pole of

circulation, may be thought about as a thing unto itself; as a means of coalescing, witnessing, and sensing. Infrastructure here is not under attack (a perspective which justifies new means of resilience and control); it is a participant in an intervention against the logistical metrics according to which it is usually measured.

If we continue to think along lines of strategy and tactics; circulation and disruption, then the more fundamental issue of our logistical entanglements go undisturbed. Disruption is conceived as being generally 'bad', or perhaps 'good' on occasion only if the thing we disrupt is itself a 'bad' thing; the source of a wider crisis that threatens us. The question of disruption itself, as a mode of disentangling, is left to one side. Part of the challenge therefore is identifying the processes of entanglement and subverting them. Initially, we can think of this as a subversion of content. With digital and dynamic signage (including dynamic advertising) for instance, there is a possibility for redirection. Like the street signs of Baltimore in *The Wire* – points of logistical ordering converted into tools of deception by the drug gang simply by rotating them on their posts – logistical images can be performed differently. More importantly however, there is the question of subverting function and form; subverting the arrow itself, turning the immediacy and ease of the logistical image or the interface into something that begs reflection or pause. On Olympian Way, along the bank of the Thames and in the shadow of the O2 arena, there is a signpost that reads 'Here 24, 859', indicating how many miles the sign is from itself (Fig. 37). Made to UK road furniture standards, Thomson & Craighead's 2013 installation demonstrates the possibility for turning logistics in on itself; for turning cues for onward movement into cues for hesitation.

Figure 37: 'Here' (Thomson & Craighead, 2013)

An aesthetics of delay would then, in the case of the Underground, mean developing different ways of knowing and interfacing that influence not only the functionality of the system (whether it circulates or not) but also the experience of the space itself, the question of what it is for or what it does. The availability of open data provides some initial opportunities here. For instance, the artist Bruno Imbrizi's (2013) audio-visual *Experiment #7*, an online 3-dimensional Tube Map which uses TfL's data stream to create an interactive but distinctly *non-logistical* diagram of lines which, rather than moving and interchanging across a horizontal surface of 45° angles, appear instead to snake and weave through one-another, climbing and dipping in a knotted, tangled network, a network that *looks both playful and like hard work* (Fig. 38). This is an interface, yet it is less an interface aimed at navigation or 'journey planning' than an *interface of disorientation*. Rather than taking us out of the network as a means to moving efficiently within it, the interface takes us into its midst even as we stand outside, splitting our now-perpetual sense of panorama into the incomplete, whirling oligopticon from which it is composed.

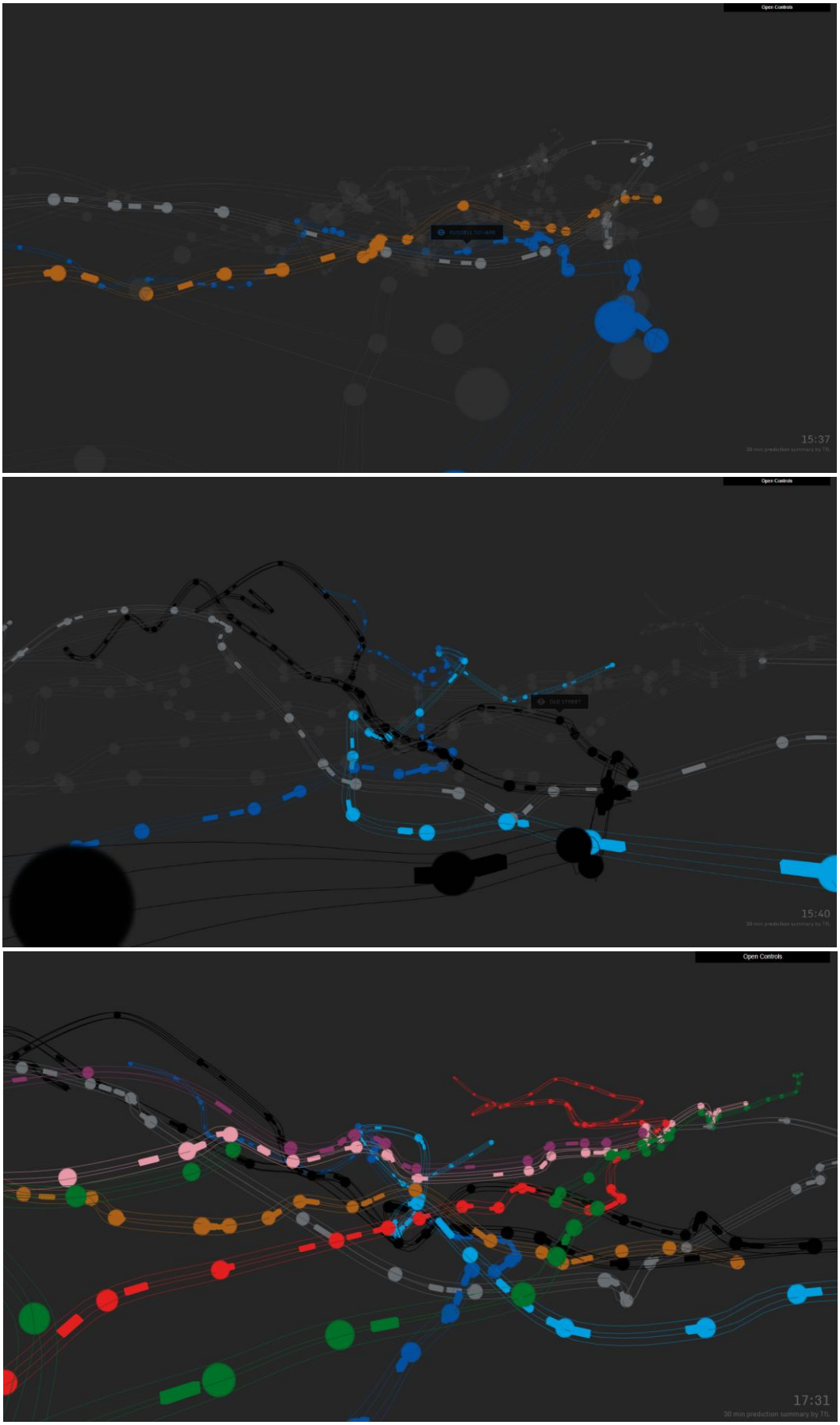

Figure 38: Bruno Imbrizi's (2013) Experiment #7

At the same time however, Imbrizi's work remains simplistic in nature, and retains the logistical aesthetic of sealed, universal containers moving through an empty, asocial space. Beyond disorientation then, it does not work to radically alter one's conceptions and get one to think otherwise about the potential of infrastructure. It may beg hesitation, but does so through what is itself a 'logistical strategy', a representation of the moving whole. It does not seek to disturb the more iterative cues encountered from within.

Perhaps more interesting in this regard then is the practice of 'ad-hacking' or 'subvertising'. 'Ad-hacking' consists in the removal, replacement, or defacement of advertising in order either to protest against advertising in public space itself, or to protest against the particular product or idea being advertised. This practice is not unique to the Underground. However, due precisely to the carefully regulated branding of the LU (discussed in chapter six), this environment offers unique opportunities. For instance, one collective, the Special Patrol Group, have exploited the standardised and carefully controlled nature of LU advertising posters in order to create – working in concert with individual artists and protest groups – a range of 'subverts' in Johnston sans font and deploying the same spacings, forms, and symbols as official signage (Fig. 39).

Figure 39: Subvertising LU Brand Poster (source: Brandalism, 2017)

The subvert thus realises the potential for subversion created by logistical power's reliance upon mobile attentiveness. It creates what Cronin (2008: 110-112) refers to as spaces of dissonance, not via the juxtaposition of a representation with a reality which contradicts it, but via an internal dissonance between the affective and aesthetic invocation of the familiar, reassuring font, colour, and circular form, on the one hand, and the message which unexpectedly offers up a political claim to be considered, on the other.

As the notion of 'tube etiquette' discussed above betrays, there is always a moral aspect to understandings of circulation, value, and risk, even in seemingly 'technical' contexts. By encouraging 'solo activities', this takes us ever-further from infrastructure as a form of sociality, sensing, witnessing, or even care (Simone, 2015: 381). What the 'subvert' has the potential to do in the unique environment of the Underground is to confront not only these moralities of conduct and self-conduct, but also to examine, critique, and subvert the particular way in which infrastructural spaces and subjectivities are interacted with, governed, and performed. This is not just a tactical intervention, it is a logistical intervention that inserts itself into the midst of the feedback between the system as a whole and the fragmentary moments of direction that sustain it, functionally and, increasingly, financially. If logistical power is about minimising risk within and extracting value from these moments, then the critical task is to ask how such moments can be repurposed as a way of drawing out alternative forms of infrastructural sociality through delay and hesitation itself.

7.8. Final Remarks

The three vignettes which introduced this thesis expressed a desire to account for the diversity of urban circulatory governance.

From thereon in, the arguments put forward have constituted an attempt to account for this diversity through the oscillation and feedback between different, seemingly contradictory spaces, scales, patterns and interests: systems and bodies; strategic overviews and tactical, solitary gestures; centralisation and dispersal; real-time modelling and hesitant, momentary glances; rapid onset emergencies and dwindling revenue streams; risks and opportunities.

I have called this oscillatory function logistical power. Logistical power mediates between the tactical and the strategic, but this is not all it does. Since logistics increasingly carves out a space for itself, between A and B, its timing – 'just-in-time' – is not merely or even primarily that of departure and arrival. Rather, it is the timing within circulation itself, which will allow not only its optimisation but also the extraction of its underexploited potentials.

The problems with this logistical form of power, as I have seen it, are twofold, expressed both institutionally and in a more everyday sense. On the one hand, it ushers in the corporatisation of infrastructure (or, perhaps, of the infrastructure of infrastructure) such that commercial imperatives trump issues of accessibility or service quality. On the other, it functions through a constant mobile attentiveness to and entanglement with cues of risk or value which leaves little room, spatially, aesthetically, or affectively, for alternative conceptions of urban space and urban infrastructure.

In order to grasp, critique, and potentially disentangle ourselves from this form of power, we would do well first to reverse the Rancièrian slogan of police, to exclaim: 'Hang on! There's something to see here!' – and then to address this, not just to the system as a whole, but to the logistical processes along its conduits.

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